JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE STATE OF PENNSYLVANIA,

FOR THE

PROMOTION OF THE MECHANIC ARTS.

OCTOBER, 1847.

## CIVIL ENGINEERING.

*Remarks on the Report of Mr. James Walker and Capt. Simmons, on the late failure of the Chester Bridge.*

We have before us the report of the officers, sent down by the Commissioners, to examine the Dee iron bridge, the breaking of which caused the fatal accident on the 24th of May. Upon the whole, the document is a pretty fair one, but more valuable for the facts it contains, than for the opinions it offers. The conclusions the reporters came to, are—

"That the bridge was of sufficient strength, if the cast and wrought iron be supposed to act together, each taking its equal portion of the strain.

"That there is great difficulty in insuring the joint action, and that, if this is a part of the principle of the bridge, we do not approve it.

"That neither the wrought nor cast iron, taken separately, was sufficient for perfect stability, and that, to have insured this, the cast iron girders alone, should have been of sufficient strength to carry the whole weight, with an ample allowance for the various circumstances, (some of them peculiar to this bridge,) which we have explained.

"That, with the exceptions of the bends or warps in the top flanges, the castings are of good quality.

"That the wrought iron is of good quality.

"That the stone-work of the piers and abutments is good, and in no way contributed to the failure."

Our readers will remember that this bridge is a skew bridge, con-

structed of straight cast iron girders, and consists of three equal spans of 98 feet each. The girders rested on four stone piers; two land piers at the extremities, and two piers in the bed of the river. The girders were straight, about 35 feet long, with an upper and a lower horizontal flange or foot, the lower being three and a half times the length of the other. Artificial shoulders were also bolted on to the upper ends of each girder, to give a greater pressing space at each joint; and the wrought iron tension rods were fastened to the top of the shoulders of the girders resting on each stone pier, and then passed down to the bottom of the girder, where the second girder joined the first, along the bottom side of the second, and again obliquely up to the top of the shoulder of the third girder, resting on the pier. The object of these tension rods, which were bolted to the joints of the middle girder, with the first and third, was to give strength to the bridge. Upon this point we do not see our way clear to offer an opinion, without more study of the principle than we can afford time to give it. We, however, may be permitted to call attention to a practical proof of an observation, which we made in opposition to the opinion of the jury, about the time of the inquest. The jury seemed to admit that the bridge was strong enough for a train to go gently over it, but not rapidly. Upon this we observed, that the pressure of a train in rapid motion ought to be less than that of one moving slowly. That, it seems, has been proved by Captain Simmons. He found that "an engine and train, of 48 tons, gave a deflection of 2·40 inches, while the deflection caused by the same train, at a speed of 15 or 20 miles an hour, was only 1⅛ inch."

It must, however, be observed, that the characters of these deflecting causes are not the same. The deflection from the train in motion approaches nearer and nearer, as the velocity is higher, to that caused by percussion, the deflection at rest being that due to simple pressure This is one reason why we should always have no immediate contact, or rigid material, between the rails and the girders of iron bridges. They should be as far as possible asunder, and the material between them be of the nature of caoutchouc, to deaden and destroy the percussive effect of the train. Though we are not friendly to iron bridges, we have little doubt in our own mind, that the fall of this bridge was the consequence of some blow, and not of the natural action of the train. But the statement of the engine-driver, that he was fifty feet from the end of the bridge, when he felt it giving way, and that he laid on the full steam, and then, by a sort of leap or bound, "succeeded in clearing the bridge with his engine, and dragging the tender up after him," borders too much on the marvellous, to find credence with us. We have no faith in such statements, simply because they are impossible. An engine, if it were loose, could not be made to bound—it is too weighty—and, in connexion with the train, it is miraculously absurd. No; the engine must have been much nearer than the man states. Probably the forepart of it was over, or nearly over, the pier; and then, as the bridge was falling in the middle, it formed an incline, up which the engine, by its momentum, might have been carried, and pulled the tender up after it.

The reporters came to the conclusion, that the "immediate cause of the accident" was, "by the tender having got off the line, and broken the girder by a heavy lateral blow."

In the opinion of its being a lateral blow from something, we concur, but whether it was from the tender, or any other part of the train, does not appear clear to us. The Report, however, is very well managed to agree with all sides. With the opinion of Mr. Yarrow it agrees, that the girders were not, alone, strong enough to support the bridge; with the opinion of Mr. Stephenson it also agrees, that the bridge was quite strong enough, IF the tension-rods added their strength to that of the girders; and with Mr. Stephenson, and some others, it also agrees, that the fall was caused, not by a fracture from the pressure, but from a side blow. It has, therefore, the admirable property of fanning the vanity of all parties, siding with all, and opposing none. It is perfectly Walkerian, and will go either way, and every way.—But the little IF, about the utility of the tension-rods, it leaves IF still; so that, *if* future inquiries should prove them useful, the reporters will not be wrong,—and, *if* useless, still they will not be wrong. It really requires great address to draw up a Report of this kind, which, like a weather vane, will accommodate itself to any and every wind that blows. No man in the profession, that we have ever heard of, except Mr. Walker, could do it. We, therefore, congratulate Captain Simmons on having so wonderful a master, by whom to learn to model his Reports, and to be able to say everything, agree with everybody, and settle nothing. Lond. Railway Mag.

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## *Improved Locomotive Engine.*

For some time past, considerable attention has been excited among parties connected with locomotive transit, by the performance of an engine built upon a new principle, by Mr. Crampton, civil engineer, [see Athenæum, ante, p. 391,]*—and upon which very extensive experiments have lately been made, on the London and North-Western Railway. The engine in question, which has been, for a few weeks, taking the express, mail, and ordinary trains on that line, and performing its work in such a manner as to effect a saving of from 20 to 50 minutes, in a through distance of 50 or 60 miles, was tried last week without a train, for the purpose of testing its rate of speed: when it was found that, with Capt. Coddington, Inspector-General of Railways, Capt. Simmonds, Assistant-Inspector, and the patentee, Mr. Crampton, on the engine, it attained the extraordinary speed of 75 miles per hour, on a level, immediately after surmounting a rising gradient; and that, at this great rate, there were a total absence of all vibration, and a steadiness of movement perfectly surprising. These great advantages are effected in Mr. Crampton's engine, by the centre of gravity being brought down to its lowest possible point; the boiler, in fact, being, in this machine, within two feet nine inches of the rails, whilst, in engines of the old construction, it ran, at the very least, five

* See, also, Journal Franklin Institute, page 143—present vol.

inches (?) above their level. The peculiarities of this engine consist in the driving-wheels being placed at the foot-plate end of the boiler; by which means, the boiler itself can be brought down close to the supporting axles of the engine—and, from the peculiarity of form before mentioned, any size of driving-wheel may be used, without interfering with the position of the boiler, so that longer boilers can be used if necessary. Another advantage, secured by this method of building engines, is, that no part of the engine overhangs the wheels; inasmuch as the fire-box is extended under the boiler and driving-axle—by which, also, the distance between the extreme wheels is reduced three feet. The engine in question, the Namur, has only 13 feet between them, whilst, in ordinary engines, the same amount of power would require 16 feet. In addition to these advantages, the driver has the whole of his machinery in view at one time, and, in no case, is required to get under his boiler for repairs. So satisfactory have these and other trials been, that the North-Western Company have ordered of the patentee, an engine, of a power nearly equalling that of the monster engine on the Great Western Railway; which it is thought, when completed, may, perhaps, by its performances, tend materially to set at rest the long-pending dispute, as to the superior eligibility of the broad or narrow gauge. Athenæum.

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### *Warming and Ventilation of the New House of Peers.*

We have been requested to give an account of the system adopted by Mr. Barry, for the warming and ventilating the new House of Peers. We cannot do better than give Professor Faraday's account, read at the Royal Institution:—

Mr. Barry's plan of warming and ventilating the three rooms, to which he has applied it, (*i. e.*, the royal ante-chamber, the House of Peers, and the public lobby,) consists, first, in causing a current of air, of regulated temperature, to pass beneath the impervious floor of these apartments, and afterwards to rise to a chamber at the top of the building, from whence it is diffused in great abundance, but imperceptibly, throughout the three apartments; and secondly, in drawing off the vitiated air, and discharging it with great rapidity into the atmosphere. To accomplish these objects, Mr. Barry has achieved expedients for, 1. Warming the building through an impervious floor, as in the case of a Roman bath. 2. Effecting a system of currents. 3. Providing means of causing ten thousand cubic feet of air per minute to proceed in a prescribed course, and with regulated velocity.

The warming is effected by a steam-cockle, supplied from one of Lord Dundonald's boilers; it is traversed by a quantity of air-tubes, firmly fastened into it. The air which passes through the tubes, is the source of warmth. This apparatus, with its furnace, is placed beneath the public lobby; and the current of warm air passes beneath its impervious floor, then beneath that of the House of Peers, and lastly, beneath the floor of the royal ante-chamber beyond. With warmth, the air acquires a certain degree of motive power in the rising

parts of the passages, which carries it onwards, till it reaches the reservoir chambers at the summit of the building; from thence, it is made to pass down into the apartments by their walls, and so distributed, without draught, to be breathed by the inmates of those rooms. This gradual diffusion of the air is accomplished by a system of currents. It is caused by subjecting the air to inequalities of temperature. Descending by the walls of the building, it is cooled by windows, &c., and thus its velocity downwards is increased. Arriving at the level, at which it is at once heated, and deteriorated by respiration, combustion, &c., the air again rises in the centre of the room, and passes through the ceiling, into a foul-air chamber, which is in connexion with a chimney. Through this chimney, the air is driven by the third expedient adopted by Mr. Barry, viz., draught of the flue,—and a peculiar motive power furnished by Bell's steam jet, a source of force which has so many philosophical considerations connected with it, that Mr. Faraday expressed it his intention of making it the subject of a future day's discourse.* He therefore limited himself, at present, to the simple statement that steam, produced under 32lb. pressure on the square inch, will set in motion 217 times its bulk of air.

In the course of his communication, Mr. Faraday described the arrangements made by Mr. Barry, to clear the air, and to regulate its velocity, so as to prevent the possibility of draughts coming on any inmates of the apartments. He showed how the steam-cockle, employed to give warmth in winter, might, by filling it with water from the Artesian well, become a source of coolness in summer. These, and many other important arrangements, were illustrated by sections in relief.

The advantages expected from this mode of ventilation, are, 1. The prevention of local draughts. 2. The prevention of the stains and disfigurements resulting from such draughts. 3. The avoidance of all movement, and dispersion of dirt and dust of the house, by currents occasioned in it, which currents, if existing, would tend to render the air impure. 4. The avoidance of all sudden change of temperature. Finally, it was noticed that all parts of the house were fire-proof.—Mr. Faraday then took occasion to remark, that this scheme of ventilation was under a disadvantage in the present case, as it had to be adapted to buildings which were not planned with reference to it.

Civ. Eng. & Arch. Jour.

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## BIBLIOGRAPHICAL NOTICE.

### *The Bankers' Magazine.*

We have received several numbers of "The Bankers' Magazine, and State Financial Register," published at Baltimore, until the number for September, which bears on its cover the imprint "No. 17 Wall Street, New York." The editor and publisher is J. Smith Homans.

This magazine is specially devoted to the dissemination of information concerning the Statistics of Banking and State Finances; the

* See page 212 of the present volume.

Principles of Banking and Currency; Decisions in the Law Courts of America and England, on questions connected with the business of bankers and banking; matters relating to Insurance, Savings Banks, &c.

The pages of this monthly periodical contain much well digested and practical information, on subjects relating to finance, and money statistics in general. It should be in the hands of all who have the direction and management of institutions established for fiscal purposes, and will also be found useful to individuals, whose business is of such a nature, as to embrace extensive banking or financial operations. We know of no publication, of this kind, better adapted to convey useful and reliable information, concerning the subjects to which it is devoted, and recommend it to the notice of such banks, bankers, financial institutions, and persons connected with business of this kind, as have not yet availed themselves of the knowledge to be acquired from its perusal.

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## FRANKLIN INSTITUTE.

### *Monthly Meeting, August* 19, 1847.

The usual business of the Society was transacted, the Correspondence read, Donations announced, Reports from the Treasurer and the various Committees received, new members proposed and elected, &c.

The next order of business being Communications on Subjects connected with Science and the Arts:—

*Mr. S. W. Roberts*, who had recently returned from a visit to the "Mammoth Cave," in Kentucky, laid before the meeting a map of the cave, on which are traced the intricate windings, and intersections, of the numerous passages constituting this subterranean wonder, which now, by the assistance of guides, may be safely explored by visiters, for a distance of nine miles from its entrance. Its dark avenues are crossed by several considerable streams, across which visiters are ferried in boats, and in which several kinds of fishes may be caught.—These inhabitants of waters upon which the light of day never shines, are of a dull white color, and are, apparently, entirely destitute of the usual organs of vision. One of these eyeless fishes, taken from a stream in the cave, about four miles from its entrance, was presented to the Institute, by Mr. Roberts. He gave a brief and general description of the cave, accompanied by some interesting statements of his observations, while exploring the interior of this vast subterranean recess.

We hope Mr. R. will furnish, for the Journal, a more extended and minute account of his visit to this remarkable cavern.

*Mr. Picot* exhibited a cooking apparatus, called the "Calefacteur Cuisine," made by Lemare, of Paris, and imported for Mr. P. It is constructed chiefly of tin, and consists of an outer cylinder, about 10 inches high, and of the same diameter, within which is an elliptical

vessel, whose longer and shorter diameters are, respectively, 9¼ and 6½ inches,—the space between this and the outer cylinder, being kept filled with water when the apparatus is in use. This place for containing water has two apertures, one, consisting of a pipe or funnel, in the permanent cover which unites the inner and outer vessels, through which the water may be introduced; and the other, a small elbow-pipe, bending outwards and downwards, for conducting off the steam. There is also a common brass stop cock inserted in the side of the outer vessel, near the bottom, from which hot water may be drawn. The interior elliptical vessel is two inches higher than the cover which unites it to the outer cylinder,—this projecting portion being pierced with holes, to allow the escape of gas from the fuel.—Through the double bottom of the interior vessel, there is a circular opening, 1½ inches in diameter, to supply a draught of air for the combustion; this opening may be partially or wholly closed, by a sliding valve or register. A movable elliptical plate, of pierced sheet iron, is fitted within the inner vessel, near the bottom, on which the charcoal used for fuel is sustained. In the empty space above this, the boilers, single and double, together with sauce pans, stew pans, coffee roaster, and various other accompanying conveniences for cooking operations, may be inserted at pleasure. The steam pipe communicates with a detached lateral vessel, of the same shape and size as the inner elliptical container, in which vegetables, or other articles of food, may be prepared by steam, while the other portion of the apparatus is employed in boiling or roasting.

The whole apparatus is exceedingly neat and compact, and appears to be well calculated for the saving of both time and fuel. Mr. Picot said, that, with one pound of charcoal, costing less than two cents, a dinner of seven different dishes, roast, boiled, and stewed, sufficient in quantity for seven or eight persons, may be cooked in the usual time, and with much less attention, than is required in the ordinary methods in common practice. The space between the inner and outer vessels, being always kept filled with water, presents a constant supply, ready heated for use; and, in case of a delay in serving up the dinner, after the cooking is completed, all the viands may be kept hot, for an hour or more, by simply closing the register, to prevent the admission of cold air into the furnace, after the extinction of the fire; the cistern of hot water, which surrounds the inner vessel, imparting sufficient heat to the cooked articles, to maintain them at the desired temperature for a considerable time. The escape of heat is also prevented by an exterior hood or covering, so constructed as to envelope the whole apparatus.

This very convenient and economical contrivance, is deserving of attention from our ingenious workers in tin and sheet iron.

*Mr. G. W. Smith* offered, for the inspection of the members, a polished transverse section of a bar of railroad iron, (H pattern,) which had been immersed in very dilute nitric acid, and connected with a plate of pure silver, in order to produce galvanic action; the unequal degree of corrosion thus produced upon the different laminæ of iron composing the bar, displayed the direction of these laminæ, and their

arrangement as produced by the action of the rollers. Mr. S. announced his intention of making further experiments in relation to this subject.

A specimen of *Gutta Percha*, presented for the Cabinet of the Institute, by Mr. Lennig, was submitted to the examination of the members present.

This is an article of recent introduction into commerce and the arts, having been first brought into notice in England, towards the close of the year 1843. It is used by the Malays, to form handles for knives and other implements, being preferred by them, for such purposes, to wood or horn. It is procured from a tree which grows abundantly in Malacca, in Borneo, and some of the islands of the Indian Ocean. This tree yields a milky juice, which, when coagulated in masses, forms the substance known as gutta percha.

The color of this article is a dark grayish brown, and it has somewhat the appearance of horn, being, below the temperature of 50°, nearly as hard as that material, exceedingly tough, and only flexible in the state of thin slips. By an increase of heat it becomes more flexible, and, at a temperature considerably below the boiling point of water, a mass of it becomes so soft as to be easily cut with a knife, and may be divided into portions of any size, and moulded into any desired form. If a hard and rigid mass of it be dipped into boiling water, until it becomes heated throughout, it is rendered as plastic as clay, and, on again cooling, returns, unchanged, to its original hardness and rigidity. When in a soft state, it may be separated and joined again, so perfectly as to show scarcely any appearance of the joint, and the united mass is as firm as if it had never been divided. Being moulded into any shape, while in the plastic state, it will retain the same form upon cooling; and it is an important fact, that these processes of softening, moulding, and hardening, may be repeated any number of times, without injury to the material. When cold, it possesses but little elasticity; its tenacity, however, is very great, a writer in Chambers' Journal declaring that "a thin slip, of only an eighth of an inch in substance, sustained a weight of 42 pounds, and was only broken by a pressure of 56 pounds." Though differing greatly from caoutchouc, in its hardness and flexibility, it appears to have some of the properties of that substance; burning brightly when ignited, and giving forth the peculiar odor emitted by india rubber when burned. It is soluble, with difficulty, in ether, and other solvents of caoutchouc; but dissolves readily in spirits of turpentine. In its chemical relations, gutta percha differs little from caoutchouc. The specific gravity of the former is 0·9791; and of the latter, 0·9355. According to Soubeiran, an analysis of gutta percha, in a state of purity, yielded carbon 87·8, hydrogen 12·2; and caoutchouc, according to Faraday, gives carbon 87·2, hydrogen 12·8.

This substance promises to be extensively useful in its application, and a number of patents have already been secured in England, with reference to its employment in the manufactures and the arts. In its hard state, it may be used for purposes to which india rubber is not applicable, and, in solution, it appears to be well adapted for many

purposes for which that article is now used. Its toughness, and hardness, would seem to fit it as an admirable substitute for leather in many cases; and, as a cementing agent, it will probably be found of great value. One of the patentees proposes to combine gutta percha, caoutchouc, and another substance, called *jintawan*, by which an elastic compound may be formed, which is impervious to water, and in which, by varying the proportions of the ingredients, it is said that any requisite degree of hardness or flexibility may be obtained. In its various modifications, from a substance as hard as ivory, down to a liquid solution, to be used as a varnish, it is scarcely possible to imagine the multiplied uses to which it may be applied. Time, experiment, and practice, can only determine the extent of its application to useful and ornamental purposes, and its consequent value and importance as an article of commerce.

*Mr. T. B. Adams* exhibited some specimens of gun cotton, prepared by Messrs. C. & F. Lennig, of Philadelphia, in December last, which had remained since that time, loosely wrapped in paper, but which still retained their explosive quality in full degree. He proceeded to make some observations concerning the qualities and uses of this article, and referred to a number of experiments, made by himself and others, in order to test its effects, as compared with those of gunpowder.

Gun cotton, he said, is improved by immersing it in a weak solution of nitrate of potash, after having been washed from the acid. For blasting rocks, or in mining operations, he considers it greatly superior to gunpowder; its freedom from smoke rendering it particularly desirable to underground miners. Being compressed into cartridges of a proper form and size, the operation of charging is greatly facilitated; and, not being liable to be spilled or scattered about, as gunpowder is, there is much less loss and danger of accident, than where powder is used. He regards its action upon the rock as less wasteful than that of gunpowder, inasmuch as it cracks or severs the material, without throwing it into the air, or pulverizing it;—an important consideration to coal miners. These reasons, he says, have induced the English miners, generally, to adopt it, and a considerable saving has resulted from its use.

With regard to the use of gun cotton in fire arms, Mr. A. said that the experience of many sportsmen has shown that it is superior to gunpowder, on account of its initial force,—its making no smoke,—the recoil being less,—and the report weaker than when powder is used. Well prepared cotton leaves no foulness in the barrel, and the gun only requires cleaning when put away after use. Respecting the corrosive action of gun cotton on the barrel of the piece, Mr. A. said, that Mr. Dupont had made an experiment, using a tube of iron, from which he fired 60 grains of cotton, in 30 charges, by which the tube lost five grains in weight. Mr. Adams then produced a tube, which he said was carefully washed in alcohol, and weighed at the United States Mint, previously to its being used. After firing from it 177 charges of gun cotton, covered by wads, the tube was again carefully weighed, and the loss was found to be only $\frac{8}{10000}$ of an ounce troy.

In relation to the comparative force of gun cotton, as compared with powder, Mr. A. presented the following results of experiments: With a gun barrel, 20 inches long, using a charge of about 30 grains of cotton, shot of No. 9 size were driven, at a distance of 25 yards, through 51 leaves of a book; and, with 20 grains of cotton, through 30 leaves. With the same barrel, and the same distance, using a charge of 1¼ drachms of Curtis & Harvey's powder, shot of the same size were driven through but 23 leaves. With another barrel, 31 inches long, a charge of 1¼ drachms of powder drove the shot, at 25 yards, through 21 leaves of the book;—and 18 grains of cotton through 12 leaves. With a pistol barrel, 7 inches long, charged with 9 grains of cotton, No. 7 shot were driven, at 10 yards, through 22 leaves; and, with a charge of 12 grains of cotton, through 34 leaves. He also referred to experiments made in blasting with gun cotton, at the coal mines near Pottsville, in which very satisfactory results were obtained.

In connexion with this subject, *Prof. W. R. Johnson* said, that during the last week he had witnessed a trial of gun cotton, in a rifle, and in blasting rocks. From four to six grains of the cotton were found to be an ample charge for the rifle, giving a sufficient projectile force for a distance of 100 yards. He thinks that, when the gun cotton is properly used, the danger of bursting fire arms, and the recoil of the piece, are not greater than in the use of gunpowder; and conceives that further experiments will establish this as a fact. The experiment in blasting, at which he was present, was considered imperfect, owing to a defect in the mode of application, and, therefore, not such as to admit of a comparison with the effect of gunpowder.

*Mr. S. W. Roberts* expressed a hope that gun cotton, in connexion with the safety fuse, would be brought into general use, for blasting and mining; considering it to be more convenient of application in certain situations, safer in practice, and the liability to accident less than in the common method of blasting by means of gunpowder.

*Prof. W. R. Johnson* submitted a verbal statement of the result of an examination of the scales adhering to the interior of the boiler of the Government steamer "W. L. Marcy," presented at the last meeting of the Institute.

The specific gravity of these scales is 2·695. They are laminated and crystalline, with minute prismatic columns crossing the thickness of the deposite. The color is nearly pure white; the side which appears to have been next to the metal, is marked with small black specks, apparently of oxide of iron.

Their hardness is such, as to allow of being scratched with the nail, but the side which adhered to the iron is perceptibly harder than the other. Acids produce, on them, no effervescence or other evidence of reaction.

It had been stated, at the time these incrustations were presented to the Institute, that the use of *ammonia* in the boiler, had been found to obviate the difficulty arising from this deposite. Doubts, however, had been expressed, whether the remedy were due to a true chemical reaction.

Presuming that, by *ammonia* was meant *sal ammoniac*, some trials

were made, to determine the efficacy of that salt, in dissolving the scale, as compared with one or two other reagents applicable to the same purpose.

Having weighed 38 grains of the scale, in small fragments, but not pulverized, they were boiled for an hour, with 27 grains of chloride of ammonium, (sal ammoniac,) in about four ounces of distilled water, until no farther effect appeared to be produced. The scales had become rather more friable than before, but their form and structure were unchanged.

The liquid, with the washings of the undissolved fragments, treated with chloride of barium, gave of ignited sulphate of baryta 4·05 grains, proving that about 1·39 grains of sulphuric acid had been already brought into solution.

The undissolved scale, dried at 212°, was found to have lost 2·9 grains, or 7·6 per cent. As the scale had, at first, been weighed without drying, a small part of this loss is probably attributable to hygrometric moisture.

The residue was next boiled in a solution of carbonate of potash;—the resulting sediment separated, washed, dried, and heated a little below redness, and found to be completely soluble, with effervescence, in chloro-hydric, nitric, and acetic acids. The solid crystalline scale had, in fact, been converted into a pulpy or flocculent mass of carbonate of lime.

The liquid which had been filtered from sulphate of baryta, after boiling with sal ammoniac, having first been freed from excess of baryta, gave, with oxalate of ammonia, a copious precipitate, showing that *lime* had been dissolved.

On the other hand, the liquid filtered from carbonate of lime, having been acidulated and boiled, gave, with chloride of barium, equally abundant proofs of the presence of *sulphuric acid.*

The foregoing trials prove that sal ammoniac *is* capable of reacting chemically, to dissolve, in part, the incrustation; and carbonate of potash, to decompose without completely dissolving it;—leaving, at least, carbonate of lime, insoluble, and capable, under certain circumstances, of still forming a scale.

It being thus made evident that the incrustation is one of the sulphates of lime, and, by negative proofs, ascertained that the clean scale contains no other essential material, an analysis was performed, which resulted in showing that it belonged to the same species as the crystals formerly analyzed by Prof. Johnston, of Durham, containing two equivalents of dry sulphate of lime, to one equivalent of water; in other words, it was *di-hydrated* gypsum, $=2CaO,SO^3+HO$.

To prove more exactly the relation between the respective solvents, 10 grains of the scale, freed from dirt, were finely pulverized, heated to dull redness for 20 minutes, losing thereby three per cent. of water, and then boiled in three successive portions of a strong solution of sal ammoniac. By this treatment, almost exactly *one-half* of the dried powder was found to have been dissolved. The remaining half was boiled with 20 grains of pure carbonate of potash, in four ounces of

distilled water, by which it was rendered completely soluble in chloro-hydric acid.

Wood ashes may probably be substituted for carbonate of potash, without serious inconvenience; and, to aid the decomposing power, as well as to give completely soluble compounds, acetic acid, or even common vinegar, may take the place of chloro-hydric acid.

To prove the utility of this solvent, (the acetate of potassa,) a quantity of acetic acid was slightly supersaturated with carbonate of potash, and a portion of the powdered scale was boiled in the solution for about one hour. A few light, flocculent particles only remained undissolved, indicating a superior facility of decomposition, to that of chloride of ammonium, and yielding acetate of lime, and sulphate of potassa,—both soluble salts.

Besides the scale of the sea steamer, trial was made of one, similar in aspect, obtained some years ago, from a stationary boiler used at or near the glass works of Mr. Bakewell, in Pittsburg. That scale had, likewise, a crystalline structure, with small transverse prisms. It had a dirty white color, was marked with black specks on the side which had adhered to the boiler, and was, without difficulty, scratched with the nail. It was not attacked by acids.

When 19·8 grains were heated to bright redness, for more than an hour, the loss was ·55 grain, or 2·77 per cent. As the color and lustre of this scale are less remarkable than that of the sea steamer, the sulphate of lime is doubtless contaminated with some earthy impurities, and probably with a little animal or vegetable matter, but the quantity of water expelled, clearly indicates that it belongs to the same class of hydrates as the seawater scale.

In fact, as it is known that a temperature of 300° expels the water from common gypsum, it is inconceivable that true *bi-hydrated* sulphate of lime should be formed within a vessel, in which prevails a temperature often above that limit.

Two or three varieties of scale, from boilers using the water of the Schuylkill, were compared with those above described.

The first was from a boiler used at Smith's factory, near Fairmount. This scale is dark grey, and, in many parts, almost black. It has a slight scent of animal oil. This odor became abundantly perceptible, on heating to 400° or 500°, and the thick smoke, and strong smell of lamp-oil, leave no doubt as to the source of this impurity. Exposed for 10 minutes to a dull red heat, in daylight, it lost 8·65 per cent., nearly the whole of which was organic matter.

Treated cold, with chloro-hydric acid, till effervescence ceased, and then boiled with an excess of acid, it lost 83·66 per cent. more, leaving a nearly black powder, (part of which was proved to be sulphate of lime,) amounting to 7·69 per cent.

Hence, the predominant material in this scale, that to which it owes its chief properties, is carbonate of lime. Faint traces of the crystalline structure, already observed in the scale from salt water, and in the Pittsburg scale, were also found in this, and may, probably, be due to the portion of sulphate of lime ascertained to be present.

A second scale, of a character similar to the last, from the boiler of

Mr. Coggins, also consists chiefly of carbonate of lime, of a reddish brown color; and a third, from the connecting-pipe of a boiler, which exploded a few years since at Kensington, is of the same general character, but less compact, and of a nearly flesh-red color. An obvious solvent for this scale, will also be found in acetic acid, or in a substance which can yield that acid to the lime.

## SPECIFICATIONS OF ENGLISH PATENTS.

*Specification of a Patent granted to* Alfred Vincent Newton, *of the County of Middlesex, for an invention of improvements in the method of heating, hardening, and tempering various articles made of steel, or of iron and steel combined.*—Sealed 24th September, 1846.*

This invention consists in the construction and application of certain apparatus, which is intended to ensure the proper heating of articles required to be hardened or tempered. The apparatus represented in the drawings accompanying the specification, was designed principally for the heating, hardening, and tempering of axes; but, under proper modifications, which will readily suggest themselves to any competent workman, every variety of article, requiring to be submitted to such processes, may be treated according to this invention.

For heating axes or other similar articles, a heating furnace is constructed, in the form of a vertical cylinder. The exterior of this cylinder may be made of sheet-iron, say four feet eight inches in diameter, or varying therefrom in such a degree, as shall give to its interior a diameter of four feet, when lined with fire-brick;—its height may be about three feet. In the interior of this cylinder, several fire-chambers are formed, the number of which is usually four, dividing the circle of brick lining into eight equal parts, so that there shall be a space of fire-brick between each of the fire-chambers. The inner wall of each fire-chamber is formed by a circle of three feet four inches in diameter; each of the fire-chambers is, therefore, about eighteen inches long, about four inches from front to back, or from one of its circular sides to the other, and it may be about four inches also in depth; the ends of each of the chambers may be parallel, or nearly so. Under each there are grate-bars, and air is supplied to them through a pipe, connected with a blowing apparatus.

A circular table, usually of cast-iron, three feet four inches in diameter, (which is the same with that of the interior circle of the fire-chambers,) is made to revolve slowly, on a level with the upper part of the said chambers. This table is sustained on a central shaft, which passes down through the bottom of the furnace, and has its bearing in a step below it; a pulley, keyed on to this shaft, serves to communicate rotary motion to the table.

When the axes or other articles are to be heated, they are placed

* Patent obtained by D. C. Collins, of Collinsville factory, Connecticut. Specification prepared by the Editor, T. P. Jones.

upon the table, with their bitts or steeled parts projecting so far over its edge, as to bring them directly over the centre of the fire; and the table, on which they are thus situated, is kept slowly revolving during the whole time of heating; the time required being governed by the size of the article under operation. When duly heated, they are ready for the process of hardening.

The hardening bath consists of a circular tub or vat, wherein the hardening liquor (usually composed of water containing salt) is placed. Within this tub or vat, a little above the surface of the liquid, is a wheel, mounted horizontally, and made to revolve by means of a band and pulley. Around the periphery of this wheel, a number of hooks or pins are provided, upon which the axes or other articles are to be suspended, as they are taken from the furnace; the height of these pins from the liquid, is such as will allow the lower part only, or bitt, to be immersed therein. The temperature of the hardening liquid is kept down, by having a large reservoir thereof in the ground below the tub or vat; from which reservoir fresh liquor is pumped into it, as required; and that which has been heated is allowed to flow back again into the said reservoir, which, being a few feet below the surface of the ground, and of considerable capacity, preserves the liquor at a sufficiently low temperature. As soon as the hardening of the steeled portion is effected, the axes or other articles are removed from the hooks or pins, and the heads are cooled by dipping them in cold water.

Fig. 3. Fig. 1. Fig. 2.

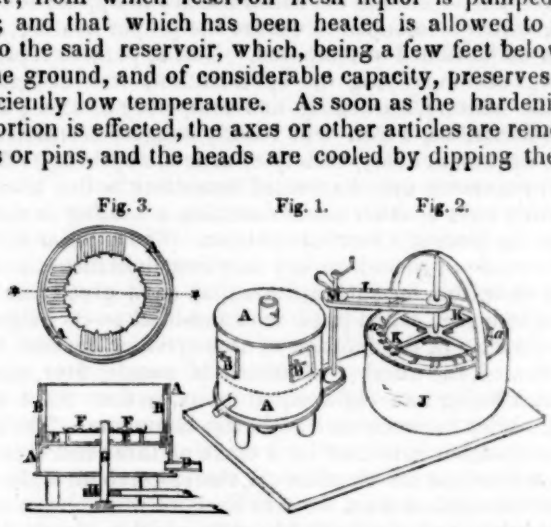

Fig. 4.

Figs. 1, and 2, represent, in perspective views, the furnace and the hardening tub; fig. 3, is a plan view of the interior of the furnace, the upper part, or top plate thereof, being removed; and fig. 4, is a vertical section, taken in the line * * of fig. 3. A, A, is the furnace; B, B, are the furnace doors, through which the fires are fed, and the articles to be hardened are adjusted; C, is the chimney for carrying off the gaseous products of combustion; D, the pipe for supplying air to the fire; E, E, the fire chambers; F, the revolving table, upon which the axes, or other articles to be heated, are placed; and G, is a vertical shaft, provided with a winch-handle, and carrying a pulley H, which, by means of an endless band I, communicates rotary motion to the pulley, on the shaft which supports the table F, and thus causes it to revolve.

J, fig. 2, is the hardening-tub; and K, is a wheel, mounted horizontally in the tub J, and furnished, on its periphery, with pins or hooks

*a*, *a*, upon which the axes or other articles are to be hung. This wheel may be kept revolving by means of an endless band L, passing round a pulley M, on the shaft G, and also round a pulley on the shaft of the wheel K.

It is well known to persons intimately acquainted with the manufacturing of edge-tools, that the most difficult part of the operation of hardening and tempering, is the giving of a uniform and proper degree of heat to the piece to be hardened. The exact degree of heat to be given, will, it is true, vary according to the nature of the steel to be operated upon,—as, what is called high steel, will require to be less highly heated, than that known as low steel; the experience and judgment of the operator being the only guide in this particular. But, whatever be the quality of the steel, the equal heating of all its parts is of the utmost importance; and, in articles of any considerable size, this cannot be effected in the ordinary mode of procedure, with an open fire. Where articles are unequal in thickness, as is usually the case, the difficulty is much increased; but even where the thickness is equal, the difficulty is not removed. When the articles to be heated are placed over an open fire, one side of the steel is exposed to its action, and the other, in a greater or less degree, to that of the atmosphere, and the utmost care and skill cannot entirely overcome the unequal heating resulting therefrom.

In the apparatus which forms the subject of this invention, it is stated that all parts of the steel may be equally exposed to the action of the fire, the intensity of which may be increased as the articles become heated, and all danger of heating the thin more highly than the thicker parts, is removed; they are, consequently, equally expanded in all their parts, and the danger of producing cracks or other injurious effects, from unequal contraction in hardening, which often destroys the tools, does not exist.

It has been already stated that the apparatus, as herein described, is so formed as to adapt it to the heating and hardening of axes. To these, the table F is particularly adapted; but, for the support and exposure of other articles to the action of the fire, the outer edge of the table must be furnished with devices, adapted to them in a manner that will occur to any competent workman.

The improved method of tempering articles manufactured in whole or in part of steel, is similar to that above described for heating such articles for hardening, and consists in submitting them, for a sufficient length of time, to an atmosphere or bath of heated air, which is to be brought up to, and kept at, the temperature required for the tempering, and which will vary according to the nature of the steel employed, and of the tool or other article to be tempered. To effect this object, the inventor constructs an oven, which may be formed of iron or other material; and, with this oven, a furnace and air-flues are so connected and arranged, that the air contained in the oven may be as highly heated as is deemed necessary, whilst its temperature can be regulated by the introduction of cold air at any time. For the purpose of ascertaining the temperature of the oven, a thermometer is employed, the bulb of which is to be exposed to the action of the air contained in

the oven. The articles to be tempered may be placed on a carriage or wheel, which may be made to revolve or move within the oven; the air will, by this means, be in some degree agitated, and the articles to be operated upon will be made to occupy different parts of the oven. A device of this kind may not be absolutely necessary, but it is undoubtedly useful and convenient.

Fig. 5. Fig. 6.

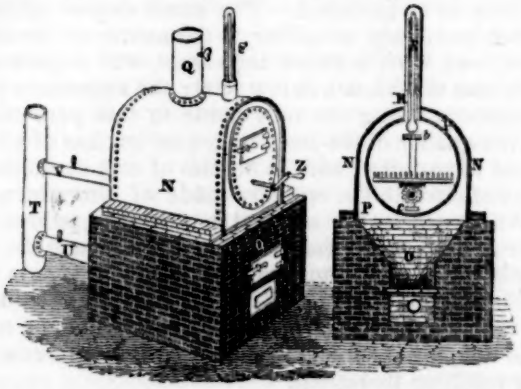


Fig. 5, represents, in perspective view, an oven and furnace intended for the tempering of common axes, but which will also serve for edge tools, swords, and cutlery of all kinds; and fig. 6, is a vertical cross section of the same. N, is the oven, set immediately above the furnace O, the heat from which passes through the flue-space P, P, surrounding the oven; Q, is the escape-flue for the heated gases; R, is an open tube leading from the interior of the oven to the external air, and through this a thermometer is passed, in such a manner that its bulb shall indicate the temperature of the air within the oven; S, is a thermometer placed within this tube; T, is a blast-pipe, through which air is to be conveyed to the ash-pit of the furnace, from any convenient blowing apparatus, and from this the tube U, leads into the ash-pit, to supply the air necessary to combustion. V, is a tube leading also from the tube T, into the oven; and through which cold air may be blown, when the temperature of the oven is to be reduced; or the same may be effected by other modes, as by the opening of the door, which has been ound sufficient in practice. The tubes U, and V, are furnished with stop-cocks, to regulate the passage of air through them. This mode of tempering will apply equally to tools which have been hardened, whatever may be the process of hardening. W, is a horizontal wheel, fixed on an axis X, and made to revolve by means of bevel gearing, as shewn at Y; the axis and winch Z, serving to communicate the desired motion. *b*, and *c*, are bars placed within the oven, and made fast to its ends to sustain its axis X.

When axes are to be tempered, they are passed into the oven through the door-way, and placed on their heads, around the wheel W, which may be furnished with projecting pins, to keep them in their place. When properly arranged on the wheel W, the door is closed,

and the wheel is made to revolve slowly. During the operation, there will be a continuous current of air passing out through the tube n; which current will cause the thermometer, contained in the tube, to shew the exact temperature of the air within the oven. With the best cast steel, a temperature of 510° of Fahrenheit's scale has been found to produce a perfectly good result in the tempering of axes; and the time required to bring them up to this degree of heat is about 45 minutes. For smaller articles, less time will be required, and that in proportion to their substance. The inventor states that no injury has been found to result from keeping the articles longer in the oven than is actually necessary, when the temperature was maintained at the same degree; a thing in which there is not the slightest difficulty, under the foregoing arrangements. It will be manifest, also, that the temperature of the oven may be graduated, so as to suit high or low steel, as well as to adapt it to the degree of hardness required in the articles operated upon. This process is entirely free from the uncertainty resulting from the test of color, so generally relied upon; and also from the varying fusibility of metallic alloys which have sometimes been used for tempering.

The oven, as above described and represented in the drawing, is constructed of iron, and for those of a small size, it may be best to form them of this material; but they may be constructed, also, in whole or in part, of brick or stone, which are bad conductors of heat; and their form may be varied in any convenient manner. If built entirely of bricks, or other bad conductor of heat, it may be found advisable to introduce heated air, by means of air-tubes passing through the furnace, as well as to provide the means of introducing cold air: this and other changes in the arrangement of the parts, may be made according to the choice or judgment of the constructor.

The patentee claims, First,—the manner herein set forth, of constructing the heating furnace with an enclosed fire, and having four, or any other convenient number of fire-chambers, arranged circularly around or under the top of a table, which is adapted to receive the articles that are to be heated upon it, and which is made to revolve during the time of heating, substantially in the manner and for the purpose herein set forth. Secondly,—in combination with the heating-oven, the apparatus herein described, for hardening the article thus heated; the said apparatus consisting of a revolving wheel, situated above the surface of the hardening liquid, which wheel is furnished with pins, hooks, or other devices, suited to the particular articles to be operated upon; the whole being arranged substantially as described. And, Thirdly,—the manner herein set forth of tempering articles, formed in whole or in part of hardened steel, by the action of air, heated to the requisite temperature within an oven, by means of a suitable furnace; which oven is provided with the means of ascertaining and regulating the temperature of the air, as described.—[*Inrolled March*, 1847.]

Lon. Jour. Arts & Sci.

*Specification of a Patent granted to* Baron Charles Wetterstedt, *of the county of Middlesex, for Improvements in the manufacture of Sheet-metal, for Sheathing and other purposes, in preventing the Corrosion of Metal, and in preserving Wood and other materials.*—Sealed 3rd November, 1846.

The first part of this invention consists in manufacturing lead, combined with a small quantity of antimony, into sheets for various purposes. The lead is melted, and regulus of antimony is added thereto in the proportion of from one to two parts, by weight, to one hundred parts of lead; the mixture, after being well stirred and skimmed, is run off and rolled out into sheets. The patentee says that he is aware that lead and antimony have been before combined together; he does not, therefore, claim the same generally; this part of his invention consisting merely in combining antimony with lead in such proportions as will allow of the compound being rolled into sheets.

The second part of this invention consists in manufacturing copper, combined with a small quantity of antimony, into sheets for various purposes; and in combining certain other metals together, and rolling them into sheets. The patentee adds to every two hundred pounds of copper in the refining furnace, when it is ready to be run out, about one pound of regulus of antimony, and two or three pounds of calcined soda, heated to nearly the melting point; the metal is well stirred and skimmed, and then it is run into moulds, and afterwards rolled. In carrying out the second improvement, the patentee employs two furnaces, placed side by side, one containing refined copper (prepared as described in the preceding improvement, or refined in the usual way), and the other Muntz's patent yellow metal; an iron mould, coated with clay and sand, is made red hot, and into it is poured one part of copper to four or five parts of yellow metal; but previous to the yellow metal being poured in, a small quantity of melted tallow is sprinkled over it, with a brush, for the purpose of cleaning it; the yellow metal is then poured in, and the whole mass is in a fit state for rolling into sheets. If preferred, brass may be substituted for the yellow metal. The same process may be employed for producing a combination of lead and tin; the two materials being used in the proportion of four or five parts of lead to one of tin or tin and lead combined.

The third part of this invention consists in certain methods of preventing the corrosion of metals and preserving wood and other materials.

A paint, for effecting these objects, is prepared by melting two or three parts of copper with one part of regulus of antimony, and running the mixture into water; after which it is dried by a gentle heat; then two parts of oxide of copper are added, and the whole is ground; the mixture being moistened during the operation of grinding with as much naphtha as will bring it to a thick pasty state. The metallic composition thus made is reduced to the required consistence, in order

that it may be used as paint, by the addition of a solution composed of tar and naphtha in equal parts. When preparing paints in which zinc or lead is to be employed, the patentee uses antimony in the proportion of one and a half parts to one part of zinc or lead; and when tin is employed, the relative proportions should be two parts of antimony to one of tin. These materials are melted together, run into water, and ground, as above described (the oxide of copper being omitted); and they are brought to the required consistence by the addition of oil and turpentine and suitable drying ingredients, or of the solution formed of tar and naphtha, before mentioned.

Another composition or paint, which may be applied to the metal, wood, or other material, previous to its being coated with the above paints, or which may be used alone as a preservative, is made by melting together thirty pounds of tar, thirty pounds of pitch, twenty pounds of dried soot, and four pounds of tallow or sperm oil; a sufficient quantity of naphtha being added to bring the mixture to a suitable consistence.

Another plan for preventing corrosion is by immersing sheets of copper and zinc and copper and zinc nails in a solution composed of muriatic acid of commerce sixty pounds, oxide of copper or old copper ten pounds, and regulus of antimony three pounds; the sheets and nails being allowed to remain for two or three days in the solution, which is to be kept at a temperature of not less than 70° Fahr.

The patentee claims, Firstly,—the mode of manufacturing sheet-metal by combining lead and antimony. Secondly,—the mode of manufacturing sheet-metal by combining copper and antimony; also the mode of combining copper and yellow metal, to be afterwards rolled into sheets of sheathing, and for other purposes; also the mode of manufacturing sheet-metal by using lead and tin; also the treating of sheet metal and nails as above described. Thirdly,—the modes of preparing or combining materials to be employed as paint for the prevention of corrosion of metals, and also for the preservation of wood and other materials.—[*Inrolled May*, 1847.] Ibid.

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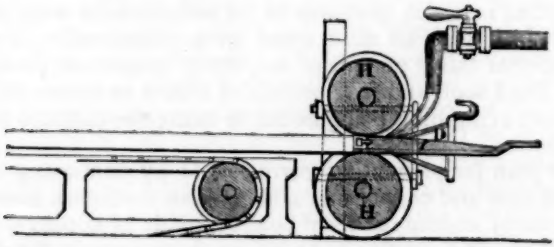
*Specification of a Patent granted to* James Roose, *of Darlaston, of the county of Stafford, Tube manufacturer, for certain Improvements in Welded Iron Tubing.*—Sealed August 29, 1846.

The improvements consist, first, in taking a strip of iron of the required length, breadth, and thickness, according to the size of tube, and beveling or chamfering the two edges of the lap joint, as is well understood amongst tube manufacturers; then turning the two sides of one end of the skelp or strip when at a red heat, the two edges curling towards each other, and one lapping under the other, so that the first end is made smaller than the size of the tube when finished; the skelp, or partly turned and partly flat strip, is then put into the furnace, and when brought up to a welding state, it is introduced into

a bell or mouth-piece, D, similar to that shown in the engraving, and the turned-up end is sufficiently inserted through the bell and between the rolls, H, H, to allow the plyers on the drawbench to catch hold of the end of the skelp; the chain being then set in motion, the skelp will draw through the bell, and, owing to the ridge on the bell, the one end of the skelp will be caused to overlap the other edge, and when it has left the bell, and it is in the pinch of the rolls, the place of contact of the rolls being the point which gives the welding pressure, the mandril being within, and offering resistance to the internal




part of the tube. Between the back part or small end of the bell, and the entrance of the rollers, there is a tube, *c*, through which is conveyed either hot or cold blast, blown by the engine; the end of this tube is fixed over the seam of the skelp or tube. The blast will have the effect of reducing the metal at the seam or joint into a partly liquid state, or state of fusion. The rods revolve by machinery, and traverse at the same surface speed as the chain on the drawbench, so that the draft on the tube is eased, and the draft has not a tendency to stretch the tube more in one place than another, nor to pull the tube in two. The mandril is placed in front of the bell, the bulb protruding through and into the groove of the rolls. By this process, the skelp, with the one end turned up, is produced at one heat, and at one operation, into a lap-joint welded iron tube. This process will be found most advantageous in the production, particularly of lap-joint iron tubes, on account of the small quantity of hands required, the very great facility it offers in their production, and the superiority of the articles produced. They will be found to stand a greater pressure on the inch, according to the substance of metal, than other similar tubes produced by any of the other known processes, on account of the properties of the iron being retained, the tube only having been heated once. By other processes the tubes are repeatedly heated in the furnace, which tends to destroy the fibres of the iron. Another very great advantage resulting from this process, is in the blast playing on the seam or joint of the tube before it goes under the welding pressure, so that in all cases dependence may be placed on the joint being in a good welding state, which joint might in some degree have got chilled in the bell or mouth-piece, in the bending.—[*Inrolled February* 27, 1847.]

Civ. Eng. & Arch. Jour.

*Specification of a Patent granted to* GODFREY WOONE, *of the county of Middlesex, for certain Improvements in the Art of Engraving in Relief.*—Sealed 11th March, 1846.

This invention consists in certain improvements in the formation of engraved surfaces, having the character of wood engravings or types, and applicable to the production of prints and illustrations of books, and to the printing of paper-hangings, cotton, silk, and other fabrics; the impressions presenting the appearance of tinted copper or steel-plate engravings, or tinted lithographs.

These improvements are classed under three heads, viz., first, the direct modes of engraving, or those by which the engraving is formed directly upon the plate from which the impressions are to be taken; secondly, the indirect modes, or those by which an engraving in relief is obtained on some material or substance that is not sufficiently hard to print from, and is therefore used as an original to take casts from, fit for printing; thirdly, the intaglio mode, or that by which the printing surface is obtained from a mould in a substance coming under either the first or second of the above heads.

Under the first part of the invention five new kinds of tools are described, and certain methods of breaking up the etching ground are explained. The first tool is made by taking a steel plate, one-fourth of an inch thick, and laying on it a mezzotinto ground; the second tool consists of a steel plate, on which an aquatinto ground is bitten, in such a manner that, if printed from, it would yield impressions entirely black; the third tool is formed by "machining" two sets of lines diagonally across a copper plate, at right angles to each other, and biting in to a considerable depth, so as to leave a surface of dots; the fourth tool is made by taking from the last-mentioned plate an electrotype cast, one-fourth of an inch thick, the surface of which will present the appearance of a square net-work; and the fifth tool consists of wire-gauze:—for a medium ground the gauze should be about eighty squares to the inch. The patentee says that these tools have never before, to his knowledge, been used for a similar purpose; and he therefore claims the right of using them in the ordinary process of copper-plate engraving.

The mode of employing these tools is as follows:—Upon a copper plate, of the required size, an ordinary etching ground is laid, and the patentee, having selected one of the tools (which he slightly rubs with black lead, to prevent adhesion), places the etching ground side of the plate and the prepared side of the tool in contact, and passes them through a copper-plate press; on carefully separating them, the etching-ground will be found to be broken up into infinitely small particles; and a tracing of the design is then made upon it, in the usual manner. The parts intended to print entirely black are now covered, by means of a camel's-hair brush, with a mixture of Brunswick black and spirit of turpentine; and when this is dry, the plate is placed in the decomposition cell of a galvanic battery;—the patentee does not lay claim to any novelty in this part of the process, but to the means

he employs for localizing the decomposing galvanic action, and producing thereby new and peculiar effects. The plate is to remain in the cell from five to twenty minutes, according to the intensity of the action and the depth required. When the unprotected parts are slightly indented, they will form the next dark shade to black; the plate is then to be taken out, washed, and dried, and those parts of the design which are to be of this shade are covered with the above-mentioned stopping-out mixture, and the plate is replaced in the cell, and retained there for a sufficient time to produce the next shade required; these operations are repeated for every variety of shade intended to be given to the picture. A very fine effect, in imitation of tinted lithography, is stated to be produced by drawing the whole subject in at once to print in black lines, scraping or removing with a point the lines or part desired to print white, and subjecting the plate to the galvanic action until a middle or medium tint between black and white is obtained. Plates of any metal liable to galvanic decomposition may be treated according to this part of the invention. The plates, when finished, are fastened on blocks of wood of a suitable height to enable them to be worked with printing types.

The second direct method consists in reversing the ordinary mode of stipple engraving. The patentee says that he finds this mode capable of producing engravings in relief with great delicacy, especially if employed in conjunction with the other methods constituting this invention.

The indirect modes of producing engravings in relief are as follow:—One of the tools above described is heated, and upon it white wax is spread, so as to produce an even surface, by filling up all the rough or uneven parts; on this, the design is traced, and the subject is drawn with a mixture of vermillion and gum-water; when dry, turpentine is employed to remove the ground, except where protected by the vermillion, which is afterwards to be washed off with water. A cast taken from such a prepared plate will produce black lines on a middle tint; and nothing further remains to be done but to engrave any light lines or spaces required. Originals to cast from, or surfaces which may be employed at once to print from, may be made by covering a lithographic stone with an etching ground, and breaking it up by one of the tools above described; the drawing must then be proceeded with in the same manner as under the first mode, but instead of the galvanic operation it will be necessary to employ acid.

The third part of this invention, or the intaglio mode, consists in throwing a middle tint entirely over grounds in the methods lately introduced of producing a printing surface in relief, by casting or taking an electrotype impression from moulds formed by drawing or etching through a composition down to a base of metal: this may be done by machining lines entirely across the plate, or employing one of the before-mentioned tools for throwing a tint over the entire plate.—[*Inrolled, September,* 1846.]

Lon. Jour. of Arts & Sci.

*Specification of a Patent granted to* GEORGE FREDERICK MUNTZ Esq., *of Ley Hall, near Birmingham, for an improved manufacture of Metal Plates for Sheathing the bottoms of Ships or other Vessels.*—Sealed 15th October, 1846.

This invention relates to the sheathing metal described in the specification of a patent granted to the present patentee, October 22, 1832, which metal is composed of copper and zinc, in such proportions, that, whilst the copper is to a considerable extent preserved, sufficient oxidation is produced, by the action of the sea-water on the metal, to keep the ship's bottom clean; sixty parts of copper are used in this mixture to forty parts of zinc; and it has been found, that this pro portion of copper could not be reduced without exposing the alloy to injury, from the zinc being separately acted on. The present improvements consist in combining a suitable metal or metals with the copper and zinc, so that the mixture may contain a less proportion of copper than that above named; and at the same time a sufficient degree of oxidation may be produced; and a separate action on the zinc prevented.

The patentee describes an alloy of copper and zinc with another metal, which he has found to possess the same properties of oxidation as the metal described in his former specification, and yet with an important reduction in the quantity of copper employed, and, consequently, in the cost of producing the metal. The alloy consists of fifty-six parts of copper, forty and three-quarters of zinc, and three and a quarter of lead; and, in making the alloy, the patentee uses an additional quantity of zinc, on account of the loss of that material which occurs during the operation, so as to obtain an alloy containing the different metals in the above proportions. The lead is said to act a very important part in the alloy, as, without it, the combination of fifty-six parts of copper with forty and three-quarters of zinc, would not produce an alloy which would oxidize sufficiently to keep the ship's bottom clean. The alloy, after being cast into ingots, is rolled into sheets (by preference, at a red heat), which are then to be annealed; and, if desired, the sheets may be cleaned with a mixture of sulphuric and nitric acids, properly diluted.

The patentee does not confine himself strictly to the above proportions, for the quantity of copper may be increased (which will, however, increase the cost of the sheathing metal), or it may be decreased to a slight extent; but it must not be reduced to fifty per cent. of the alloy produced. Although lead is mentioned in the above description, any other suitable metal may be used in place of it, but not with equal advantage.

The patentee claims the manufacture of sheathing metal, by so using other suitable metal or metals, when copper and zinc are combined for the purpose of sheathing, as to allow the mixture to contain a less proportion of copper than about sixty parts of copper and forty parts of zinc, and at the same time attain a sufficient degree of oxidation, and prevent separate action on the zinc.—[*Inrolled, April,* 1847.] Ibid.

*Specification of a Patent granted to* Richard Albert Tilghman, *of London, for Improvements in the manufacture of certain Alkaline Salts.*—Sealed February 1, 1847.

To all to whom these presents shall come, &c., &c.—My invention consists in a method of obtaining the sulphate, muriate, and chromate of potash from the felspars containing that alkali. The felspars best for the purpose are those containing the largest quantity of potash, and the proportions of materials directed to be used in the different processes hereafter described, are calculated for a felspar containing sixteen per cent. of potash. I obtain sulphate of potash by heating together at or above redness, a potash felspar, lime, or its carbonate, and the sulphate of either lime, baryta, or strontia, and afterwards lixiviating the mixture with water. I have the materials ground to fine powder, and mix them intimately in the proportion of two parts by weight of felspar, one part of lime, or an equivalent quantity of carbonate of lime, and one part of sulphate of lime, which I prefer to the other sulphates. I place the mixture upon the hearth of a reverberatory furnace, and heat it to bright redness for about eight hours, turning the charge from time to time, so that all parts may receive equal heat. Although the formation of sulphate of potash is most rapid at a high temperature, yet I do not let the heat rise high enough to cause the fusion or agglutination of the mass, as the subsequent extraction of the salt by water is thereby rendered more difficult. The presence of a deoxidizing atmosphere in the furnace being injurious to the formation of the sulphate of potash, I admit through suitable openings above the level of the fire a sufficient quantity of air into the gases rising from the fuel, to preserve the atmosphere in an oxidizing state. When all the parts of the charge have remained at a high red heat for from eight to ten hours, I withdraw the charge from the furnace and lixiviate it with hot water repeatedly, as some of the salt adheres obstinately to the sulphate of lime. The solution of sulphate of potash is then evaporated, the sulphate of lime, which deposits during the evaporation, being continually removed. When the sulphate of baryta or strontia is used, in place of the sulphate of lime, the same process is to be pursued, but the extraction of the sulphate of potash by water is more easy, owing to the less solubility of the sulphates of baryta and strontia. When a cheap and abundant supply of sulphurous acid gas can be obtained, as from the roasting of sulphurous ores, the use of the sulphate of lime or other sulphate in the mixture may be dispensed with, by doubling the quantity of lime or of carbonate of lime before prescribed, and exposing the charge, while at a red heat in the furnace, to a current of sulphurous acid gas and air, with frequent stirring, sulphate of lime is thus formed during the process, and the formation of sulphate of potash takes place as in the former case.

I obtain muriate of potash, by heating together a potash felspar, and the muriate of either soda, lime, or iron, at a temperature above the fusing point of the muriate employed. I prefer using muriate of

soda, or common salt, which I mix with an equal weight of finely-ground felspar. The mixture is well dried and introduced into a horizontal iron cylinder, with an opening only at one end, which is closed with an iron door or cover and luted tight. For the escape of any gas that might tend to burst the cylinder, I have a small hole through the upper part of this door, which is closed at pleasure by a loosely fitting plug. The cylinder is covered on the outside with firebrick, to protect the iron from the action of the fire. The cylinder and its contents are to be heated to bright redness for about six hours; the heat should be above the fusing point of the muriate employed, but I prefer to keep it below the temperature at which the felspar would melt, as the charge would then be more difficult to remove from the cylinder. The cover is now taken off, and the charge raked out as quickly as possible into an iron pot, which is immediately covered, and kept closed until the mass is cool. The soluble salts are to be extracted from the mass by water, and the muriate of potash separated from the other salt by evaporation and crystalization in the usual manner.

The same process is pursued when the muriate of lime or iron is employed.

I obtain chromate of potash, by heating to bright redness for several hours in an oxidizing atmosphere, an intimate mixture of finely-ground potash felspar, lime, and chrome ore. The materials are ground to fine powder, and mixed in the proportion of four parts by weight of felspar, four of lime, or an equivalent quantity of carbonate of lime, and one of chrome ore. I spread the mixture on the hearth of a reverberatory furnace, and keep it at a bright red heat for from eighteen to twenty hours, stirring and turning it over frequently, so that all parts may be equally exposed to heat and air. As with the sulphate of potash, an oxidizing atmosphere is preserved by the admission of sufficient air into the chamber of the reverberatory furnace, the heat should not be permitted to rise high enough to cause even incipient fusion in the charge, which should be kept in a porous state. When an examination of the charge in the usual manner shows that it contains the proper quantity of alkaline chromate, it is withdrawn from the furnace, and lixiviated with water as in the common process.

I claim as my invention the manufacture of sulphate of potash, by heating at or above redness, a mixture of potash felspar, lime, and the sulphate of either lime, baryta, or strontia.

I also claim the manufacture of muriate of potash by heating together a potash felspar, and the muriate of either soda, lime, or iron, at a temperature above the melting point of the muriate employed.

And I also claim the manufacture of chromate of potash, by heating to redness a mixture of a potash felspar, lime, or its carbonate, and chrome ore, all in fine powder in an oxidizing atmosphere.—[*Inrolled July* 31, 1847.] Rep. Pat. Inv.

*Specification of a Patent granted to* Richard Albert Tilghman, *of London, for Improvements in the Manufacture of certain Acids, Alkalies, and Alkaline Salts.*—Sealed February 1, 1847.

To all to whom these presents shall come, &c. &c.—My invention consists in a method of obtaining certain acids, alkalies, and alkaline salts, by exposing, at a high temperature, certain salts containing such acids and alkalies to the action of steam or vapor of water, by which the acid is carried off and the alkaline base either remains free, or enters into combination with some third substance provided for that purpose. To obtain sulphuric and sulphurous acids I prefer using sulphate of lime, and I perform the operation in the following manner:—I have a fire-clay cylinder, of close texture and of any convenient size, placed vertically in a furnace, and provided with openings at the top and bottom for charging and discharging, which openings are capable of being closed air tight. To the top of this cylinder I adapt an escape tube of fire-clay for conveying off the acid vapor; and to the bottom, for the admission of the steam, I adapt another clay pipe connected with a steam boiler by a series of fire-clay tubes. In order to diminish the corrosion of the cylinder by the sulphate of lime or the lime itself, I line it with a coating of native carbonate of magnesia, applied in a similar manner to the usual clay linings of chemical furnaces. I fill the cylinder with pieces of sulphate of lime, about one quarter of an inch in diameter, and having luted the openings air tight, I heat the cylinder and its contents to a high red heat. I then pass steam from the boiler through the red-hot clay tubes into the bottom of the cylinder and up through the charge. The heated steam on its passage through the pieces of sulphate of lime carries off the acid in the state of sulphurous acid and oxygen, with sometimes a little sulphuric acid mixed with it. The acid vapors pass off by the escape tube at the top of the cylinder, and I convey them by stoneware tubes into a leaden chamber in order to combine them into sulphuric acid by the usual means. I take care that the heat is not raised so high at first as to melt the sulphate of lime in the cylinder, but I increase it towards the end of the operation, the charge becoming more infusible when partly decomposed. I have an opening in the tube conveying off the acid vapors from the top of the cylinder, by means of which I examine the vapors from time to time, and from the relative acidity of these, ascertained by the usual tests, I judge of the progress of the operation. I regulate by a stop-cock the quantity of steam passed through the charge in the cylinder, maintaining the supply at that point which produces the greatest quantity of acid in the vapors. When the vapors cease to contain any notable proportion of acid, the cylinder and its contents being at a high red or low white heat, I shut off the steam, withdraw the charge from the cylinder by the lower opening, and put in a fresh one to be treated like the first. The charge thus operated upon will be found to consist chiefly of caustic lime. When I wish to obtain the acid and alkaline base from the sulphate of magnesia, I first drive off by heat all its water; I then introduce it in

small pieces into a cylinder such as I have before described, and operate upon it in the manner directed for the sulphate of lime. But I take care to keep the heat at low redness at first to prevent the fusion of the charge, which would choak up the cylinder and prevent the passage of the steam. The decomposition of sulphate of magnesia takes place at a much lower temperature than that of sulphate of lime (a low red heat is sufficient), and a considerable part of the acid is given off in the state of sulphuric acid. When the charge has been treated as directed, the residue will be found to consist chiefly of caustic magnesia. When I wish to decompose the sulphates of baryta and strontia, I operate upon them in a reverberatory furnace. This mode is less advantageous for the manufacture of sulphuric acid than the use of the close cylinder formerly described, but I prefer it for the two last-mentioned salts, because I consider their bases the more important product of their decomposition, and the hydrates of these alkalies, and particularly that of baryta, being fusible, would have much tendency to corrode the interior of the cylinder at the heat necessary to decompose the salts. I use a common reverberatory furnace heated by a coke fire with its hearth covered with a compact bed of native carbonate of magnesia three or four inches thick. Several clay steam-pipes are introduced through the roof of the furnace so as to throw a current of heated steam over the whole width of the hearth; these pipes are connected with a steam-boiler by a series of fire-clay tubes kept red hot.

The sulphate, broken into pieces of about half an inch in diameter, is spread over the lining of carbonate of magnesia on the hearth of the furnace and brought to a high red or low white heat. A current of steam is then admitted from the boiler through the red hot tubes upon the charge. The acid of the sulphate is carried off by the steam, and, when I wish to collect it, the acid vapors are conveyed along with the gases of the fire into a leaden chamber to be combined into sulphuric acid by the usual means. The quantity of steam thrown upon the charge is kept at the point which produces the most rapid evolution of acid, and the charge is stirred occasionally so as to expose fresh surfaces to the action of the steam. As the contact of deoxidizing gases with the sulphate is injurious, I admit, if necessary, by suitable openings above the fuel, such an excess of air as will render the atmosphere in the furnace oxidizing. The sulphate of strontia requires a higher heat than the sulphate of lime for its decomposition, and the sulphate of baryta still higher than the sulphate of strontia. When the sulphate of baryta is partly decomposed, the mass melts and becomes more fusible as the decomposition proceeds. I judge of the progress of the operation by testing a portion of the charge from time to time; when it dissolves altogether, or nearly so, in dilute nitric acid, I withdraw the charge, which now consists chiefly of the hydrate of baryta or strontia. To obtain muriatic acid and the hydrates of baryta or of strontia, or caustic lime, from the muriates of those bases, I employ the same process as that above described for the decomposition of the sulphate of baryta. The sulphates of potash and soda may to some extent be decomposed by being subjected

at a high temperature to the action of a current of heated steam in the manner directed for the decomposition of the sulphate of baryta. But owing probably to the volatile nature of the bases of these salts at a high temperature, no large proportion of them can thus be obtained in a free state. To aid, therefore, the decomposing action of the steam, I employ some substance capable, when mixed with these sulphates highly heated and exposed to steam, of forming a combination with their alkaline bases, which shall yet when cold give up the alkali to the action either of water, or of water and carbonic acid. Of the large class of substances possessing these properties, which for convenience I will call combining substances, I prefer to use either alumina or the subphosphate of alumina. The alumina is prepared by strongly igniting the sulphate of alumina or by any other well known process.

The subphosphate of alumina is prepared (as is directed in chemical works) by mixing solutions of the phosphate of soda and the sulphate of alumina, and adding to the solution a slight excess of ammonia. I mix the alumina in the state of powder with an equal weight of the sulphate of potash or of soda, also powdered, and spread the mixture upon the hearth of a reverberatory furnace such as I have before described for the decomposition of the sulphate of baryta. The mixture is then heated, exposed to steam, stirred, and the operation conducted in all respects in the manner described for the treatment of the sulphate of baryta. When a specimen of the charge shows by the usual tests that it contains no notable proportion of the sulphate undecomposed, the operation is completed.

I then withdraw the charge, lixiviate it with hot water, and when the clear solution of aluminate of potash or soda thus obtained has become cold, I pass through it an excess of carbonic acid until no more precipitate of alumina is formed; the clear solution of carbonate of potash or soda is then drawn off and evaporated. The alumina thus recovered is again used as the combining substance. When I wish to obtain the aluminate of potash or of soda, I merely evaporate the solution above described without introducing the carbonic acid. The muriate of potash or of soda may also be decomposed when in a fused state by the joint action of alumina, or the subphosphate of alumina and steam; the operation is to be conducted in all respects in the same manner as that just described for the sulphates of potash and soda. But owing to the great volatility of the muriates of potash and soda when exposed at a high temperature to a current of air or steam, a large quantity of the muriate will escape with the steam and gases of the fire in the state of vapor undecomposed, and will be lost or will be difficult to condense. I prefer, therefore, to effect the decomposition of the muriates of potash and soda by causing their vapors, intimately mixed with highly heated steam, to pass slowly through a mass of small pieces of alumina kept at a high red heat. I use for this purpose a vertical fire-clay cylinder lined with a coating of native carbonate of magnesia to diminish the corrosion of its sides by the alkali, and made with convenient openings at top and bottom for charging and discharging, which openings should be capable of being closed air tight.

I arrange a cast-iron retort so that its tube enters directly the cylinder near its bottom. The retort should have a charging door at the top capable of being made air-tight, through which is introduced the muriate of potash or soda to be decomposed. The muriates of potash and soda will not vaporize freely, even when fused and highly heated, unless the atmosphere above them is continually changed. This may be effected by a current of steam, and I find that I can sufficiently regulate the quantity of the salt volatilized from the retort by the amount of steam which I blow over its melted surface. I therefore insert a small steam pipe into the top of the retort so as to throw a jet of heated steam upon the surface of the melted salt, and thus force its vapor to enter the cylinder. The quantity of steam thus introduced to aid the volatilization is not sufficient to decompose all the salt volatilized. The rest of the steam necessary for this purpose is passed directly into the cylinder by a fire-clay pipe entering it near the bottom and connected through a series of fire-clay tubes kept red hot with a steam boiler. Both steam pipes are provided with cocks. An escape tube is inserted into the top of the cylinder to convey the acid vapor and the vapor of any undecomposed muriate into suitable condensers. I have an opening in this tube by which I can withdraw at times a portion of the vapors in it to examine their saline and acid character. The cylinder and retort are to be so constructed and arranged as to allow their contents to be heated to high redness and upwards by any of the well known means. The manner of operating is as follows:—The discharging door being closed air-tight, I fill the cylinder with alumina in pieces of about one-quarter of an inch in diameter, and fill the retort with the muriate of potash or soda and then close both the charging-door of the cylinder and that of the retort air tight. I now bring the cylinder to a high red or white heat, and the retort to a cherry red heat, so that the salt in it is melted and ready to volatilize freely on the admission of the steam upon its surface. Steam is now passed from the boiler through the red hot tubes into the cylinder by the pipe entering near its bottom, so that it is filled with highly heated steam passing upwards in a slow current through the interstices of the pieces of alumina. I now admit by degrees a jet of heated steam into the salt retort by the pipe entering its top, and thus drive a quantity of salt vapor into the cylinder, where it mixes thoroughly with the current of steam which has entered by the other pipe, and ascends with it through the column of highly heated alumina. In its passage the alkaline base of the muriate combines with the alumina, forming an aluminate of potash or soda, and the muriatic acid, together with any of the salt vapor which may have escaped decomposition, passes off with the steam through the escape tube at the top of the cylinder into the condensers provided. The progress of the operation can be ascertained by examining the nature of the vapors which are passing through the escape tube. When these vapors contain a large quantity of salt and are strongly acid at the same time, I admit more steam through the pipe leading directly into the cylinder, and if this does not have the effect of diminishing the quantity of salt in the vapors, I lessen the quantity of steam thrown into

the salt retort, and by that means decrease the supply of salt vapor driven into the cylinder. When the escaping vapors contain but little salt, and a large quantity of acid, I consider the operation as proceeding favorably, and I always endeavor to regulate the quantities of steam passed through the two pipes, and by that means the proportions of salt vapor and steam thrown into the cylinder, so as to produce this effect. When the escaping vapors contain a large quantity of salt and steam and but little acid, the cylinder and its contents being at a high red heat, I consider that the decomposition of the salt is no longer effected in the cylinder, and I then shut off both currents of steam, withdraw the charge by the lower door, and replace it with fresh alumina. The withdrawn charge is then lixiviated with hot water, and the solution of aluminate of potash or soda thus obtained is treated with carbonic acid as before described. The lining of the cylinder should be examined occasionally and kept in repair, so that the fire clay may not be corroded by the alkali. Provided the charge of alumina in the cylinder is readily and equably permeable to the current of steam and salt vapor, the smaller the pieces of which it consists, and the greater the surface they expose to the current, the more rapidly will the decomposition of the muriate proceed. The steam used need not be of higher boiler pressure than will suffice to secure its passage through the charge in the cylinder. The subphosphate of alumina may be substituted for the alumina in the processes for the decomposition of the sulphates and muriates of potash and soda, and its action is even more powerful, but its first cost is greater. Although, to aid the decomposition of the sulphates and muriates of potash and soda by steam, at a high temperature, the use of either alumina or its subphosphate is preferred as the combining substance; yet there are a great number of substances which also possess the requisite properties, but act with various degrees of energy. Thus, many salts which already contain a certain proportion of base, will yet, when exposed in contact with the sulphates and muriates of potash and soda at a high heat to the action of steam, form a combination with the potash or soda decomposable, when cold, by water, or water and carbonic acid. The subphosphates of lime, baryta, and strontia, and the subsilicates of lime, baryta, and strontia, will, under these circumstances, combine with the alkali, and yield it to the action of water alone when cold. The sulphates of baryta and strontia, although themselves decomposable by the action of steam, at high temperatures, are still capable of thus aiding in the decomposition of the sulphates and muriates of potash and soda, and yield the alkali by the action of water. The neutral phosphates and neutral silicates of potash and soda when thus treated form basic salts, which are soluble in water, and then decomposable by carbonic acid. The alkalies, lime, and magnesia will also thus combine with a portion of free potash or soda, which may be extracted by water. Other materials are capable of being used as combining substances, but I have named those which I consider preferable.

The decomposition of the muriate of soda by the action of steam, at a high temperature, may be applied to the production of soda in

another way, videlicet, by exposing the muriate, mixed with sulphate of lime, to a high heat, and to the current of steam, and afterwards decomposing the sulphate of soda thus formed by the usual mode. For this process I use a horizontal cylinder, of close fireware, protected on the inside from the action of the lime and sulphate, by a lining of carbonate of magnesia, and provided with an opening for charging capable of being made air-tight. Into the top of the cylinder at one end a steam-pipe is introduced, and from the other end at the top, an escape-pipe connects, with suitable condensers, for collecting the vaporized salt and acid. The cylinder is half filled with a mixture of equal parts, by weight, of sulphate of lime and muriate of soda, the opening made tight, and the cylinder and its contents brought to a red heat. A current of heated steam is then admitted, which passes over the surface of the melted mixture, and carries off muriatic acid, with more or less volatilized salt into the condensers. When the steam escaping from the cylinder ceases to contain any notable quantity of muriatic acid, the operation is discontinued, and the charge is withdrawn. Its soluble salts are extracted by water, and the sulphate of soda separated from any undecomposed muriate by evaporation and crystalization. In this operation the heat should not be raised so high as to cause the decomposition, by the steam, of the sulphate of soda produced or of the sulphate of lime itself. I obtain the chromates of potash and soda by subjecting a mixture of the muriate or sulphate of either of those bases respectively with chrome ore in fine powder, at a bright red heat, to the action of a current of steam and atmospheric air. The muriatic or sulphuric acid is carried off by the steam, and the oxide of chromium is oxidized and reacts upon the liberated alkali, forming a chromate. When the sulphate of potash or soda is to be used, I mix intimately one part by weight of ground chrome ore with two parts of the sulphate of potash or soda and two parts of lime, and heat the mixture to bright redness for eighteen or twenty hours, on the hearth of a reverberatory furnace, while currents of heated steam are thrown upon its surface from pipes coming through the roof of the furnace. The atmosphere in the furnace must always be kept in an oxidizing state by the admission of a sufficient quantity of air through openings above the level of the fuel, and the charge should be frequently stirred to expose fresh surfaces to the steam and air. The lime is not absolutely required in the above mixture, but I prefer it as aiding the action and making the charge more porous. When the charge is found by the usual tests to contain a sufficient quantity of the alkaline chromate, it is withdrawn, and the soluble parts extracted by water and treated in the usual way. When I wish to use the muriates of potash and soda for the production of the chromates of potash and soda, I mix the ground chrome ore with twice its weight of powdered chalk, moisten the mixture with water, and form it into pieces of about half an inch in diameter, which are well dried. With these I fill a cylinder, having a retort and steam-pipes attached, such as are described for the decomposition of the muriates of potash and soda by means of alumina; and I proceed exactly as in that operation, except that I insert another pipe near the bottom of

the cylinder, through which I force a stream of heated air, which mixes with the ascending current of steam and salt vapor, so as to pass with them through the charge. When the nature of the vapors, escaping from the top of the cylinder, is such as I have before described, as indicating that the decomposition of the muriate ceases to be effected in the cylinder, the charge is withdrawn, and the alkaline chromate extracted by water as usual.

Though I prefer, in all the above described processes, heating the steam highly before passing it upon the salt to be decomposed, yet the same effect will be produced whenever the steam and salt are in contact at the proper temperature for the respective decompositions, whether they have both been previously heated, or one alone heated, so highly as to be able to raise the other to the required temperature. As has been before stated, some of the salts are decomposable by steam at a much lower temperature than others, but with all, the decomposition proceeds more rapidly in proportion as the heat is increased.

I claim, as of my invention, the decomposing the sulphates of baryta, strontia, lime, and magnesia, and the muriates of baryta, strontia, and lime, by exposing them at a high temperature to the action of a current of steam, for the purpose of obtaining the acids and the alkalies of these salts respectively.

I claim as of my invention the decomposing the sulphates and muriates of potash and soda, for the purpose of obtaining the acids and the alkalies of these salts respectively, by exposing them at a high temperature to the joint action of a current of steam and of alumina, or other combining substance.

I claim as of my invention the making sulphate of soda, by the combined action of sulphate of lime and a current of steam upon the muriate of soda, at a red heat.

I claim as of my invention the making the chromates of potash and soda by exposing a mixture of chrome ore, and the sulphates or muriates of those alkalies respectively, at a bright red heat, to a current of steam and an oxidizing atmosphere.

I claim as of my invention making aluminate of potash and soda, by the action of a current of steam upon a mixture of alumina and the sulphate or muriate of potash or soda, at a high red heat.—[*Inrolled July* 31, 1847.]

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## MECHANICS, PHYSICS, AND CHEMISTRY.

### *Drayton's Process for Silvering Glass.*

The Western Scientific Institution, Leicester-square, London, has lately roused itself from its former torpid state, and is now making considerable efforts in the direction of general usefulness. Several of the late meetings have assumed a more stirring aspect, and good results are to be looked for from it. Among the list of the papers recently read before the members, is one by Mr. Foord, "On Drayton's

method of Silvering Glass," comparing the improved plan with the deleterious and imperfect system lately pursued. The injury suffered by the workmen from the action of the mercury used in forming the amalgam, ought to be a sufficient reason for banishing the old system, were it even more economical, instead of more expensive, than the new process. A perusal of the report of Mr. Foord's practically descriptive paper below, will show that we do not magnify the evil.

The discovery of the process of coating glass surfaces with a film of metallic silver in the mirror form (the subject of the present paper), was, most probably, made at the suggestion of some accidental circumstance, and was, as a discovery, perfected in the hands of Mr. Drayton, not by theoretical reasoning, or a strictly inductive method, but by the laborious method of persevering in experiments, such as were by him, from time to time, considered most likely to yield satisfactory results. Nor do the many results thus obtained appear to have been classified or noted, and hence, when first put into the hands of the manufacturer, this discovery was neither more nor less than a perfectly new and beautiful fact, which had yet to be elaborated into a workable process, being surrounded with practical difficulties, and as yet deficient of those mechanical and other auxiliary appliances which convert the experience of the philosopher into the practice of the manufacturer—in fact, this discovery was made in exactly the same manner, and under similar circumstances, with the Daguerreotype; and, like that process, could not, in the present state of science, have been discovered by a strictly inductive method, requiring also, like it, an uncommon description of genius, combined with the greatest perseverance for its development; and the parallel between these two processes holds so far good that they have both passed through similar progressive steps of improvement, and have both arrived at a state of perfection in practice, while each remains without a theory. More with a view to the gratification of those interested in scientific matters, than with an idea of attracting the public attention to a new feature in commerce, this process was in a comparatively early stage of its progression towards its present perfect state, brought forward as the subject of a lecture by Dr. Faraday, on one of the Friday evening meetings, at the Royal Institution, at which time it excited that almost universal desire to become practically acquainted with its routine, which is the characteristic of what may be called popular discoveries, and which we all felt in the cases of the discoveries of Daguerre, Talbot, Spencer, and Schonbein; and, from the time when this excitement subsided to the present, the unceasing efforts for its improvement have been gradually rewarded, until all difficulties standing in the way of its practice having been removed, it has at last become a process having many advantages over the old method of silvering mirrors, and which can be carried on at a price commanding an extensive sale. Before we can make a just comparison of these two processes, it will be necessary to consider them each as at present conducted. By the old method the reflecting metallic surface is obtained by spreading out upon a perfectly flat table of slate or stone a tinfoil of a size a little larger than that of the plate to be silvered;

and having rubbed this foil perfectly flat, and having cleaned the glass to be silvered, with extreme carefulness, the mercury is flooded over the surface of the foil; and, before it has had sufficient time to amalgamate very deeply into the substance of the latter, the glass is slid on in such a manner as to push before it the greater part of the mercury and any particles of dust which may have collected on its surface, retaining between its under surface and the foil a stratum of mercury perfectly free from scum or any other matter which can effect its brilliancy; and, as soon as the glass is thus slid on, weights of cast-iron are placed over its entire surface, so as gradually to squeeze out the surplus of mercury—the object being to leave only the solid amalgam of mercury with the tinfoil, in contact with the glass surface; and the more effectually to drain off the mercury, the table is, after a certain time, inclined by a screw mechanism, upon its bearings, and ultimately the weights are removed, and the glass is gradually elevated to a vertical position; if the weight be removed before the mercury is sufficiently well drained off, or if the glass is elevated too quickly, the rapid draining of the mercury is accompanied by the insinuation of atmospheric air between the glass and the amalgamated foil, spoiling the result. As the presence of moisture would be detrimental, the silverer's workshop is kept at a comparatively high temperature. The mercury, which flows from the glass, from first to last, is carefully collected, a narrow gutter running round each silvering table, and the mercury thus collected retains in solution a small quantity of tin, which is found to be serviceable, by preventing its too rapid amalgamating action in future operations, which would be liable to dissolve the foil into holes, before the glass could be placed upon it. By the process in silvering concave or convex surfaces, it is necessary to make a mould of plaster of Paris, and to rub the foil with caution, until it assumes the curve of the surface of the glass to be silvered—in other respects, the method of silvering is the same as the preceding; it must, however, be observed, that if the curvature be deep, the process becomes difficult or quite impossible, and that surfaces of irregular curvature cannot, in any way, be silvered by this process. The process of Drayton is so far different from the preceding, that the only point in which they can be said to resemble each other is, that they produce a result of the same general appearance; and, as far as plain mirrors are concerned, applicable to the same purposes. By Mr. Drayton's process, two solutions are requisite, the silver solution containing in the proportion of 1 oz. of nitrate of silver; 2 ozs. of distilled water; hartshorn of the old *pharmacopœia* (a solution of carbonate of ammonia), 1 drachm; ammonia water, ½ drachm; spirits of wine, 3 ozs.—dissolving the nitrate in the distilled water, and filtering the precipitate of carbonate of silver; after the addition of the alkalies, and, before adding the spirit of wine to the solution thus prepared, a quantity of the essential oil is added, with agitation, in the proportion of 20 grains or more to each ounce of solution, the proportion of the constituents of the solution not being very definite. The solution thus prepared, gradually deposits a black precipitate, rich in silver, and as soon as it has ceased to do so, which happens after a day or two, becomes fit

for use. The other solution is constituted of essential oil of cloves, dissolved in spirits of wine, in about the proportion of 1 oz. of oil of cloves to 3 of spirits of wine, but may be used with almost any proportion of spirit greater than 3 to 1; if a proportionately greater quantity be employed of the oil of cloves solution, of the proportions now given, about 20 drops are to be employed for each ounce of the silver solution. The oil of cassia appears to determine the brilliancy of the metallic deposit, which is thrown from the silver solution whenever the oil of cloves solution is added thereto, and the quantity of the oil of cloves solution determines the rapidity of the deposit and the thickness of the coat of silver. The filtering of the silvering solution must not be made through filtering paper, or any other animal and vegetable fabric, but through asbestos, or some other substance, which is without action upon it.

In applying the above principle to the silvering of plain mirrors, the glass and necessary apparatus being cleaned with the greatest nicety, and the glass being placed in a suitable trough, or vessel, is flooded over with the silvering solution, to which the proper proportion of oil of cloves solution has just been added, and is allowed to remain in such position for about three hours, at the end of which time there has been deposited upon it from the solution a film of pure silver, of the greatest brilliancy, and so extremely adhesive, that it can be perfectly removed only by the action of acids. The plate thus silvered, although it is perfect in reflective power, has yet to undergo such process, as will ensure its permanence and durability; to this purpose it is placed on an incline, and washed by repeated currents, or floodings, of distilled water—so as to remove from the back all extraneous, resinous, and other matters, products of the chemical action, to which this precipitation of the silver is due; and is then wheeled on a carriage into a kiln or oven, raised to a proper temperature, and where it remains for several hours. As soon as withdrawn, it is protected at the back by a coat of black varnish, and is then so durable, as not only to stand under all ordinary circumstances, but likewise to withstand the action of the most rigid tests that can be applied to it. Now, as this process is performed through the medium of a fluid, it happens that glass surfaces, of any curvature, can be silvered—in short, that we can silver the inside of any glass vessel, into which we can introduce the solution, even the finest capillary tubes. Now, as the silver is gradually deposited in close contact with the polished glass surface, it presents, of necessity, a counterpart surface also, of the most perfect polish; and as its metallic resplendence is entirely due to the compactness of its structure, and the perfection of this surface, it follows, that the film of silver is required to be no thicker than to be opaque —hence in this process, silver is employed at about the same cost as that of the old process, with amalgamated tinfoil. If a thick coat be for experiment thrown down, it will be found that the deposit becomes less and less compact, as it becomes more distant from the glass surface—so that at the back of the glass we find a black pulverulent sponge of metallic silver, which owes its blackness to the extreme fineness and want of aggregation of its particles. To prove that the me-

tallic lustre is owing to the degree of compactness of the particles, it is only necessary to rub down a little of any precipitated ductile metal, either in its finely-pulverulent black state, or, that of a grey, unmetallic-looking powder, to communicate to it, by the coherence of its particles, the highest degree of metallic lustre. Without attempting any theory for this new process of silvering, it may be remarked, that the solution of silver contains also materials of a deoxidating nature, and that the addition of a solution of essential oil of cloves brings about such a change, that the silver is gradually deposited upon the sides of the vessel in which it is contained, and upon the surface of such solid substances as may be contained in it, much in the same way as a body in crystalizing does not deposit crystals equally throughout its bulk, but by preference, on the sides of the containing vessel, or upon the sticks, or strings, which have been introduced as a nucleus for their deposition. Whether the silver be contained in the solution as an amide, or in any complex organic compound, I do not pretend to offer any opinion. When Baron Liebig was in England, he appeared much interested in the process; and, so far from offering an explanation of its principle, he took away a phial of the solution for investigation, promising to write in due time respecting it; and his communication has not, up to this time, been received. In concluding these remarks, I may observe, that the compounds prescribed by Mr. Drayton, may be replaced by others of similar properties—thus, the oil of cloves may be replaced, I am informed, by oil of pimento, and, perhaps, also by such other of the essential oils as have an acid character; but, until the theory for this process be given, the limits, within which these substitutions lie, cannot be determined. To compare the new process of Drayton with the old method of silvering, it may be observed, in relation to the comparative rapidity of the processes, that by the old plan the process takes many days, the glasses draining mercury after they are fixed, unless they have been allowed to stand a sufficient time, the mercury so running off spoiling any gilt work on which it might happen to settle. By the new process the glass is returnable within 48 hours—in many cases, glasses which have been sent to the Paris depot in the morning (of which I will speak presently) for silvering, have been returned in the evening, quite dry, varnished, and in perfect condition—the silvering taking three hours, the remaining time being taken up in the kiln drying, and in allowing the two coats of protective varnish to become dry. In respect to quality, the color of the tin amalgam is a bluish-white, that of the silver coat is a purer white, which, if colored at all, approaches more to a warm tint, having a superior brilliancy and power of reflection—a difference sufficiently obvious by daylight, but more especially so by gas or any other artificial light, so much so, as to promise economy in the lighting of large apartments, decorated by mirrors of this description. In respect to comparative durability, without being too hasty in speaking positively respecting a matter of two or three years experience, I may say, that, since the process has been perfected, the most rigid tests have been applied with most satisfactory results; the mirrors have been suspended for weeks in positions in which the atmosphere has

been charged with sulphuretted vapors, without suffering the least change; and those manufactured at the opening of the business, are, at this day, as perfect as those just completed—it is permanent in sunshine, and not affected in damp—may be carelessly, and even roughly, handled—and, as for the durability of the protective varnish, it has even remained in a stove at 70° Cent. (158 Fahrenheit) for 15 days, without, in any degree, suffering—not so with the old process, the amalgam being so far decomposable by the volatilizing of the mercury, that most old glasses are more or less spotted; while, in all cases, it is absolutely necessary to move a new glass, without even touching the amalgam, which adheres but slightly to the glass, so as to be displaced by the slightest pressure, rendering paneled blind frames, with flannel facings (in all large glasses especially) necessary, and so at least doubling the expense of the cost of silvering—no such blind frames being required with glasses silvered by the new method, so long as the frame is sufficiently strong to support the glass. Respecting the cost, I may mention that silvering by the new process, is at present charged at Paris at 8 per cent. on the value of the unsilvered plate. Lastly, but most importantly, it must be mentioned, that the old process is rapidly destructive of life, mercury being volatile at all temperatures above the freezing point of water, and considerably so at the high temperature of the silvering shop—these workmen live in an atmosphere saturated with mercury, and with little exercise or air soon exchange that disposition to activity, which would prompt them to cautiousness and cleanliness, for an apathy which permits the subtle poison to make, unobserved, its gradual, but not less certain, inroads upon the constitution, until the whole system is saturated with mercury, rendering the body indescribably loathsome, permanently impairing the action of the nervous system, producing involuntary motion of the extremities, and eventually a complete waste of both the mental faculties and corporeal system, terminating, after much suffering, in death. I do not know that the description which I have given is exactly such as a professional man would have furnished, but I have endeavored to describe, without exaggeration, what is constantly occurring, and what I have myself witnessed. It has been remarked, that when the workman is sufficiently careful of himself, he may remain at this employment for a long time without suffering any serious detriment to his health, and that the effects of the mercury are too often augmented by the habit of drinking spirits; but how rarely is it the case, that we find a man in such employment who has the energy of system to withstand the depressing effect of the workshop; and who can wonder that, when a man has by loss of health ceased to enjoy his existence, that he should sink into that apathetic state, which takes no precautions against the progress of the disease, and which flies to the use of spirit as a temporary stimulant (?), and, in many cases, even deceiving himself into the belief that spirituous drinks are a specific for the mercury? So far from taking precautions against it, the general practice seems to be, such as is *most certainly* calculated to bring about the effect in the most speedy manner,

as much so almost as if it were devised for that purpose. The men coming to work in the morning, hang up their clothes in the workshop, to become saturated with mercury in the course of the day, and, putting them on again when leaving work, hang up their working clothes to become similarly saturated by the time they come in the morning; and so from Monday morning to Saturday night, taking their food with them to work, in their pockets, as if to saturate it also with the poison, and to prevent them the chance of a breath of fresh air during the dinner hour. This system, however, is not to be considered as a point of negligence on the part of the men, but as a consequence of the apathetic state, the natural result of confinement in the silvering workshop. With the new process, there is no injurious exhalation whatever; the nitrate of silver solution will stain the hands if spilled over them, but, as hands stained in this manner point out the careless workmen, this point must be allowed to be an advantage, productive of dexterity and carefulness; hands so stained remain black for several days, when the skin peels off without further inconvenience; all that can be said against the spirit and the essential oils is, that they would form by their mixture liquors of too palatable a quality to be safely trusted about in their unmixed state.

In conclusion, I beg to remark that at the Paris depot, under the direction of the perfector of the process, M. G. F. Tourape, there have been silvered and sent out, in execution of orders, during the last four months, between 500 and 1000 large glasses, averaging sizes between a 100 by 66 and 36 by 27, of which a shipment of about 25 large glasses was made to China; and that the trade is now making such progress, that we may fairly expect to see it before long a matter of at least very general adoption—not only for plain mirrors, but as a new element in decorative art, and an auxiliary to optical and general science. To suggest, for example, a few of the many purposes to which this invention is applicable, I may mention, in conclusion, the covering of the unsightly iron pillars, which disfigure the appearance of shop windows, with silvered glass tubes, or columns, and lacquered brass or gilt enrichments; the fitting up of large chandeliers with vase-shaped centres of silvered and cut glass, which would produce a refulgence as yet unobtained; for theatrical purposes it would be most generally useful—for curved shop faciers, for curved panels, d combined with gilt work, crimson, and other velvets and hangings, generally for cornice poles, and general decoration. Nor would it be less useful for fancy temples, and durable centre ornaments for table decoration. Indeed, for almost all purposes of decoration it may be applied; while for silvering surgeons' specula, for looking into the air, it will be available, the depth of the curves required being greater than can be with certainty silvered by the old process, and the cost of ground metallic specula being by far too expensive for general use. In short, this process is so universally applicable, that its employment is not limited by any difficulty of silvering highly-complex forms of glass, but only where there is difficulty in fashioning the glass itself.

Prac. Mech. and Eng. Mag.

*Seventeenth Meeting of the British Association for the Advancement of Science, held at Oxford, June 23, 1847.*

We have prepared, for the Journal of the Franklin Institute, the following abstract of the proceedings of the British Association at its late annual meeting. Our limits will not permit an extended notice of the many interesting scientific and practical subjects which were there discussed; and while we have made extracts from the reports of such as we conceived would be of more particular interest to our readers, we have been compelled to omit much that is deserving of attention.

The General Committee met on the 23rd of June, received reports from the Treasurer and Council, and transacted other usual business. In the afternoon the General Meeting of the Association took place, when Sir R. J. Murchison, after a short address, introduced the new President, Sir R. H. Inglis, to the chair. In compliance with the usual custom, the new President, on taking his seat, delivered an address to the Meeting, in which he briefly reviewed the state and progress of science during the past year; referring particularly to Astronomy, Physiology, Etherization, Microscopic Research, Natural History, Botany, and Electro-Magnetism, as applied to Telegraphic communications. When speaking on the last-mentioned subject, he adverted to the general adoption and rapid extension of the Electric Telegraph system of communication in the United States, and expressed his feeling of regret that this great discovery had been so inadequately adopted in Great Britain.

Other meetings of the General Committee and of the Association were held for the transaction of the usual routine business.

On Thursday, June 24, the meetings of the Sections commenced; the first being that of Section A, on Mathematical and Physical Science. Of some of the papers read before this Section, we extract the following notices, as reported in the *London Athenæum:*

*On the Atmosphere of the Moon, by* J. Grooby.—Whether the Moon has an atmosphere or body of air similar to that which surrounds the Earth, has long been a fertile subject of dispute among philosophers, some affirming its existence and others as strenuously denying it. Some, who take the negative side of the argument, have urged in defence of their opinion, the constant serenity of the Moon's surface, always undisturbed by clouds or vapors, and even the smallest of the numerous spots or maculæ which crowd her surface being at all times equally visible. This certainly would be a very strong argument against an atmosphere were the assertions on which it is founded to be relied upon. But this does not appear to be the case; for, on the other hand, there are many astronomers who affirm that the Moon is not always equally clear and distinct. Hevelius says, that he has several times found, in skies perfectly clear, when even stars of the sixth and seventh magnitudes were conspicuous, yet at the same altitude of the Moon and the same distance from the Earth, and with one and the same excellent telescope, the Moon and its maculæ

do not appear equally lucid, clear, and perspicuous at all times. He also adds, "From the circumstances of the observation, it is evident that the reason of this phenomenon is not either in our air, in the telescope, in the Moon, or in the spectator's eye, but must be looked for in something existing about the Moon, that is (I presume) in its atmosphere." Again, the existence of a lunar atmosphere has been denied because the stars, in an occultation, when just about to disappear behind the body of the Moon, retain their full lustre till they seem to touch the very edge, and then vanish in a moment, which phenomenon (it is urged) could not happen if the Moon were encompassed with an atmosphere. Here, again, the evidence of different astronomers is at variance, one party affirming and the other denying the fact. Nay, even the same individual has sometimes observed both stars and planets to undergo a change, both in brightness, form, and color, when close to the Moon's limb, while at other times he has perceived nothing of the kind. A third argument against the existence of an atmosphere (and the last I shall notice) is this. If (it is affirmed) the Moon were surrounded by an atmosphere, then the duration of eclipses and occultations ought to be diminished by means of its refractive power, and hence a celebrated French astronomer (in a Memoir written expressly on this subject), has endeavored to demonstrate that, if such an atmosphere did exist, and its horizontal refraction amounted to only 8", there could never be a total eclipse of the Sun. But (he continues) in the eclipse of that luminary, which happened in 1724, the total darkness continued for two minutes sixteen seconds. Many eminent astronomers concur with the one I have just quoted, in denying that anything like refraction can exist, or has ever been observed to exist about the Moon's atmosphere; others, equally eminent, assert that they have observed the most unequivocal proofs of it. Both Halley and Euler speak of the evident distortion observable in the Sun's limb in total and annular eclipses. The latter, in particular, says, in the eclipse of the Sun which happened in July, 1748, he observed, that when the uncovered part of the Sun resembled the Moon in her quadrature, the horns of the solar crescent appeared to be bent outwards beyond the circle in which every other part of his disk was comprehended; and when the eclipse became annular, the Sun's disk was dilated beyond the circle which formerly embraced it. This dilatation was also observed at Frankfort, and was estimated by Euler at 25". Here, then, we have one astronomer observing in a solar eclipse a refraction of 12½", while another, from his observations, denies that any perceptible refraction does or can exist. From such contradictory evidence, it seems extremely difficult to draw anything like a satisfactory conclusion. The most probable one seems to be this:—That the Moon is surrounded by an atmosphere in some respects like our own, but much rarer; and that it is differently modified by the peculiar circumstances attached to it. For when we consider that from the slow motion of the Moon on its axis the principal part of its surface is exposed to the direct force of the Sun's rays for fourteen and a half days and nights, without any intermission, and then, for a like period deprived of them, the one producing a degree of cold beyond

anything we can conceive, and the other, a degree of heat sufficient, probably (if there be water in the Moon), to produce a temporary atmosphere of steam,—have we not every reason to conclude that the atmosphere with which the Moon may be, and probably is, encompassed, is materially different in its constitution and properties from that which surrounds our own globe, and which may, in some degree, account for the contradictory statements I have just noticed? The annular eclipse of the Sun which will take place in October next, presents (I think) the most likely means of obtaining more accurate information on this subject than we at present possess.

*On some Recent and Remarkable Examples of the Protection afforded by Metallic Conductors against Heavy Strokes of Lightning. By* Sir W. S. Harris.—The possibility of guarding buildings and other structures against the destructive effects of lightning, has been made a great question in practical science—from the time of Franklin to the present day; and it is of considerable public importance, seeing the frequent damage which occurs to our beautiful churches and other edifices by strokes of lightning, to bring this question completely under the dominion of induction, observation, and experiment. The general principles which Sir W. S. Harris submitted as deducible from the inquiries to which he alluded are these:—If we imagine a ship or building to consist altogether of metallic substances, it would certainly be secure from any damage by lightning; and for this simple reason, that what we call lightning is the result of the electrical agency forcing a path through resisting matter such as the air, and extricating, with explosive and expansive force, both light and heat in its course. When, on the contrary, it falls upon comparatively non-resisting bodies, such as the metals, then this form of lightning vanishes, and the discharge assumes, if the metallic body be sufficiently capacious, the form of a comparatively quiescent current. Our object should be, therefore, in defending any building or ship from lightning, to bring the general mass so far as possible into that passive or comparatively non-resisting state it would have, supposing it a mass of metal. This is, in fact, the single and simple condition of such an application, without any reference whatever to assumed forces of attraction or peculiar specific powers manifested by certain bodies for the matter of lightning, and which really do not exist. This simple principle, by a careful mechanical arrangement calculated to render it practical and applicable to all the duties which the general structure of a ship together with its masts has to perform, is now universally carried out in the navy, with the most perfect success; so that damage by lightning in the vessels so fitted has, for the last fifteen years, quite ceased. The masts are made completely conducting by capacious plates of copper, reaching from the highest points to the keel; and are tied into one general connexion with all the great metallic masses employed in the construction of the hull, and united by the large bolts of copper passing through the keel and sides, with the copper expanded over the bottom and with the sea. It is quite impossible that a discharge of lightning can fall on the vessel in any place,

and not be at once transmitted safely by the conductors, not under the form of lightning, but under the form of a current without explosion. Sir W. S. Harris then referred to some remarkable cases.

*On Periodic Meteors, by the* Rev. Prof. Powell.—The chief object of this communication was to place on record a table of all the remarkable appearances of luminous meteors which the author has been able to collect up to the present time, supplementary to the very complete list given in M. Quetelet's second Catalogue (Nouv. Mém. de l'Acad. de Bruxelles, tom. xv.) which comes down to the year 1840. This list is, doubtless, imperfect; but the author submits it to the British Association in the hope that its deficiencies will be filled up by the contributions of other members. He wishes to annex a few remarks on one or two points connected with the theory of these appearances. The question so much disputed as the connexion of *luminous meteors* with the fall of *meteoric stones*, appears to the author to be answered sufficiently by observing—1st. That some cases of such connexion are undoubtedly established. 2nd. That daylight is necessary to trace the actual fall of matter, when, consequently, a luminous meteor would be *invisible*, unless of unusual brilliancy; while the darkness which renders a meteor *visible* precludes the possibility of tracing the fall of stones. 3rd. Matter may fall in portions or a state of division too small to trace; and there is evidence, or strong probability, of matter having a meteoric origin in various lighter forms besides that of metallic or apparently fused masses. As to the *forms* of masses known to have fallen, they are by no means generally *angular* or *fragmentary*, as sometimes asserted; in many instances being *whole*, and rounded in form—sometimes, also, broken into fragments *by their fall*. There is no evidence of a mass *bursting* to pieces by an explosion; the detonation heard may be purely *electric*. Of the *size* of meteoric masses no sufficient evidence exists. The *apparent* diameters cannot be easily determined on account of the velocity of motion. And if they could, this would only give the size of the flame (if it be due to combustion) and not that of the solid mass, if there be one. If the height be too great to allow combustion, still less can the apparent size of the electric flash be any guide or proof of the existence of any solid body at all. Such small solid bodies *may* circulate in the solar system, but not probably in any great number or of large size, unless as truly planetary or satellitary bodies, but unformed diffuse masses of matter like that of comets or the zodiacal rings we know to be circulating in many parts of space; and it is by *condensation* out of this, that, as probably the existing planets, so, also, lesser asteroids and satellites may be continually forming, as likewise meteoric masses within the sphere of the Earth's influence, agreeably to Mr. Strickland's hypothesis. The observations of Brande, Benzenburg, and others, as is well known, have assigned great heights to many meteors, varying from 5 to 500 miles. But M. Quetelet has shown (2nd Mém. de l'Acad. de Bruxelles, tom. xv.) that the *mean* height is from 16 to 20 leagues, or *within* the limits of the atmosphere. Hence the majority of them *may* become luminous from

*combustion.* Electric light can be displayed in vacuo. Hence we may have various gradations of the same phenomenon from purely electric flashes or explosions at great altitudes to more or less complete combustion at lower; by which the whole mass *may be consumed and dissipated*, or may be partially burnt, and the metallic ingredients more or less perfectly *reduced* or *fixed*, and in this condition portions or masses may fall to the earth. And the explosion is not the *bursting* of a mass, but an electric discharge: the particles or masses which fall are *portions*, not *fragments*; and the effect, instead of being one of *breaking up*, is one of *consolidation*.

Papers were also read by Dr. Forster, on Meteors, and by the Rev. T. Rankin, on Phosphoric Meteors. A lengthened discussion ensued on the reading of Dr. Forster's paper on Meteors, in which he endeavored to refute the cosmical hypothesis of the cause of meteors recently adopted by many astronomers. Dr. Forster stated that he was the first person who suggested the idea that these meteors were periodical as early as the year 1811; but that he had long ago given up the point, and attributed their apparent periodicity to changes in the electrical atmosphere. He concluded his paper by the production of a problem which explained and confirmed Aristotle's hypothesis of the cause of falling stars.

*On a New Theory of the Polarization of Light, by* Prof. Challis. —In this theory *ether* is regarded as a continuous fluid substance, and is treated mathematically on hydrodynamical principles. By means of a new general equation in hydrodynamics, which the author has discovered, he shows that a filament of the fluid may continue in agitation without lateral spreading, and that motion may be propagated along it uniformly, provided the motion consist of vibrations partly longitudinal and partly transversal, following the law of sines. Such a filament in motion is supposed to correspond to a ray of light. The sensation of light is due to the *transverse* vibrations. In a ray of common light the transverse motion is in planes passing through the axis of the ray, and is alike in all directions from the axis; in a plane-polarized ray the transverse motion is in planes not passing through the axis; and in an elliptically polarized ray the transverse vibrations are elliptical. Prof. Challis has extended his theory to the phenomena of double refraction, by a method which involves a new theory of the *dispersion* of light. He finds the surface of elasticity to be that of an ellipsoid; which is not in accordance with Fresnel's theory of double refraction. The equation of the wave-surface is, however, the same as in Fresnel's theory.

Among the other subjects which claimed the attention of Section A, we notice "A Report on Geological Theories of Elevation and Earthquakes," by W. Hopkins; "A Report on Atmospheric Waves," by W. R. Birt; "A Map of the Coast Survey of the United States," by A. D. Bache; "Observations on the general Nature and Laws of Electrical Attraction," by Sir W. S. Harris; "Suggestions for the Observation of the Annular Eclipse, Oct. 9, 1847;" "On the Cause of the Aurora, and the Declination of the Needle," by G. A. Rowell.

"On the Electric Currents by which the Phenomena of Terrestrial Magnetism may be produced," by Prof. Thomson.

From the Report of the transactions of Section B, on Chemical Science, we make the following selections:

*Report on the Influence of Light on the Growth of Plants, by* R. HUNT.—The author confirms the conclusions that seeds will not germinate under the influence of light separated from the chemical principle with which it is associated in the sunbeam; that germination being effected and the first leaves formed, light—the luminous rays—become essential to the plant to enable it to secrete the carbon obtained from the carbonic acid of the atmosphere; and that the increased action of the heat rays are essential to insure the production of the reproductive elements of vegetable life. It is found that the chemical principle of the solar rays is more active, relatively to heat and light, during the spring than at any other period of the year; that as summer advances this power diminishes and luminous force increases, whilst with the autumn both light and actinism are subdued, but the calorific radiations increased. Thus we find the conditions of the light of the seasons varying to suit the necessities of vegetable life. The production of chlorophyl, or the coloring matter of the leaves, was shown to be due to the joint action of light and actinism—the first being necessary to effect the secretion of the carbon, and the latter for the oxidation of this deposited carbon.

*On Different Properties of the Various Rays of Solar Radiation on the Daguerreotype Plate prepared with Iodine, Chlorine, and Bromine, in Producing and Preventing the Fixation of Mercurial Vapor, by* A. CLAUDET.—M. Claudet has made a series of observations upon light transmitted through certain coloring media, through the vapors of the atmosphere, and through red, orange, and yellow glasses. Having directed a camera obscura upon the sun when its disk appeared quite red, he obtained after 10 seconds a black image of the sun. The red sun had produced no photogenic effect, although the surrounding spaces had been sufficiently affected by the photogenic rays proceeding from the zenith to attract the white vapors of mercury. This proved that the red rays had no photogenic power. He then operated in a different manner; not content with the slow motion of the sun, he moved the camera obscura from right to left and *vice versâ*. In this manner the sun had passed rapidly over five or six zones of the plate. Its passage was marked by long black bands, whilst the intervening spaces were white; showing again that it was sufficient, in order to destroy the action of the photogenic rays, to let red rays pass rapidly over the spaces previously affected by them. He operated afterwards with colored glasses; after having obtained upon a Daguerrotype plate the impression of a black lace by white light, he covered one half of the plate and exposed the other half to the radiation of a red glass. The mercury developed an image of the lace on the part which had been acted on only by the white light; and the other part which had afterwards received the action of the red rays remained black. The red glass had destroyed the photogenic effect, as had

taken place with the red light of the sun. He made the same experiments with orange and yellow glasses, and obtained the same results but in different periods of time. The photogenic action of the red rays is 5000 times longer than the white light, that of the orange is 500 times longer, and that of the yellow 100 times. The destructive action of the red rays is 100 times longer than that of white light; the orange 50 times, and the yellow only 10 times. When a plate has been exposed to the destructive action of any particular ray, it cannot be affected photogenically by the radiation which has destroyed the first effect; it is only sensitive to the other radiations.

Mr. R. Hunt remarked that his own observations had led him to the conclusion, that instead of having to deal with three differently-colored rays, we had to deal with three distinct principles,—these three colors only being a property of one of them. Light, heat, and actinism he regarded as antagonistic forces; and it was only because they were found in different proportions in the three classes of colored rays that the results of M. Claudet could be in any way associated with the colors of light.—Mr. Maskelyne objected to some of these conclusions.

*Diamond Converted into Coke.—Dr. Faraday* exhibited some diamonds, which he had received from M. Dumas, which had, by the action of intense heat, been converted into coke. In one case, the heat of the flame of oxide of carbon and oxygen had been used—in another the oxy-hydrogen flame—and in the third the galvanic arc of flame from a Bunsen battery of 100 pairs. In the last case, the diamond was perfectly converted into a piece of coke,—and in the others the fusion and carbonaceous formation were evident. Specimens, in which the character of graphite was taken by the diamond, were also shown. The electrical character of these diamonds was stated also to have been changed,—the diamond being an insulator, while coke is a conductor.

At the meeting of Section C, on Geology and Physical Geography, an interesting paper *On Ancient Sea Margins*, was presented by Mr. R. Chambers, together with several others, by different persons, on the local geological features of certain places in England, and other parts of Europe.

The proceedings of Section D, on Zoology and Botany, and of Section E, on Physiology, embraced a great variety of subjects, in the discussion of which, a number of learned and distinguished members participated.

The following extracts are from the report of the meeting of Section F, on statistics:

Mr. Porter read a paper *On the Influence of Education, as shown in the Criminal Returns of* 1845 *and* 1846.—He began by repeating his refutation of Mr. Guény's theory, published in an early number of the *Statistical Journal.* He then gave the following returns of criminals, having superior education, committed to prison in the years:—

| Year. | No. of Criminals. | Of Superior Education. | | |
|---|---|---|---|---|
| 1836 | 20,984 | 191 | less than | 1 per cent. |
| 1837 | 23,612 | 101 | " | ½ " |
| 1838 | 23,094 | 79 | " | ⅓ " |
| 1839 | 24,443 | 78 | " | ⅓ " |
| 1840 | 27,187 | 101 | " | ·37 " |
| 1841 | 27,760 | 126 | " | ·45 " |
| 1842 | 31,309 | 69 | " | ·22 " |
| 1843 | 29,591 | 140 | " | ·47 " |
| 1844 | 26,542 | 111 | " | ·42 " |
| 1845 | 25,403 | 89 | " | ·37 " |
| 1846 | 25,107 | 85 | " | ·37 " |
| | 25,812 | 106 | | 0·41 . |

In a series of elaborate tables, exhibiting the returns which have just been given in almost every variety of which they are susceptible, Mr. Porter showed that female crime in the educated classes is so small that it can scarcely be received as an element in any statistical ratios. It would be impossible to render the entire argument of the paper intelligible in any reasonable space; and we are therefore compelled to limit ourselves to a summary of its results. The first is, that education appears to act as a preventive of crime by making manifest the consequences of actions. 2nd. That the crimes of the uneducated appear to be greatest in the best educated districts. 3rd. That educated females are far less liable to crime than educated males. And 4th. That among educated criminals there are fewer crimes of violence than crimes of fraud.

The discussion which ensued was just a repetition of the discussions at every meeting of the Association where the relations of education and crime have been brought forward. They related to "what constitutes education" and "what is the test of crime." Col. Sykes and several other gentlemen contended that in educational reports what we have returned are *means* not *ends*. "Reading and writing," it was said, "are no more education than knives and forks are a dinner." And again, an increase in the return of the number of persons accused may signify, not an increase of crime, but an increased vigilance of police. To homologate the two sets of returns it is, therefore, obviously necessary that there should be a definition on the part of the educationists of that species of education which they deem a preservative against crime; and a careful examination of the circumstances of the localities from which criminal returns are obtained. On these two points the discussion was animated. It was finally resolved to adjourn the debate until Mr. Neison's paper should be brought under consideration on Monday.

*On the Imports of Indian Cotton as compared with American Cotton, by* Prof. F. Royle.—He began by describing the experiments made to improve the cultivation of cotton in India by American planters invited to India at the expense of the Hon. East India Company. These planters, seven in number, conducted their experi-

ments over a wide extent of country, varied in soil and climate, in the three Presidencies. These experiments were undertaken in 1840; the most favorable country was Bundelcund, but two years of drought led to a failure. The next experiment was at the foot of the Himalayas, but hosts of insects destroyed the plants. In Coimbatore the experiment, however, was successful; better kinds of cotton were introduced, and cotton was perfectly cleaned by the American saw-gin. The cotton brought a good price in Liverpool. It appears that four thousand square miles are applicable to the growth of American cotton in the southern provinces of India. Since a new system of assessment has been introduced, at from eight to fourteen *anas* per acre, the cultivation of cotton by the natives has largely increased. Mr. Elphinstone has recently produced even better cotton than any of the American kinds, by hybridizing the native plant. The continued decrease of the price of American cotton is a fact of some importance; at the beginning of the century the price was 18d. per lb. and has fallen to 6d., a natural result of the increase of production. The demand for Indian cotton is generally dependent on the price of American cotton, and is subject to marked fluctuations. To this uncertainty Prof. Royle ascribed the weak state of the cotton commerce of India. Were demand steady, supply would be regular. Prof. Royle then produced a map of India, on which he pointed out the most favorable spots for the cultivation of cotton, stating the local circumstances of each—But these details could only be interesting to those minutely acquainted with the geography of India.

Major-Gen. Briggs detailed several experiments which had been made in 1816,—and attributed the failures to a bad choice of soil. He also stated that there was a large demand for uncleaned cotton in India, and that this cause disinclined the natives to clean their cotton.

Section G, on Mechanics, in consequence of a discussion with regard to uniting it with Section A, was not well provided with papers, and therefore held but two meetings. Among the subjects brought before it was a paper "On the Turbine," by Mr. Glyn, which was considered so valuable a communication that it was ordered to be printed entire in the "Transactions." Mr. Hodgkinson gave an account of some further "Experiments on the Strength of Iron Columns;" Mr. Ward described "an Apparatus for giving Light under Water in Diving Operations;" and some other communications were made which would have but little interest for our readers.

A number of distinguished foreigners attended at this meeting of the Association, among whom were M. Leverrier of France, Prof. Struve of Russia, Profs. Langberg and Esmark of Norway, and Prof. Nilsson of Sweden. At the conclusion of the meeting a vote of thanks was passed to the foreign gentlemen in attendance; for which acknowledgements were made by Prof. Struve in English, and by M. Leverrier, in French.

The next annual meeting is to be held at Swansea.

### *Application of the Rotary Fan-blower to Blast Furnaces.*

By the following extract of a letter from one of the members of the Franklin Institute, now in England, it will be perceived that our attention has been called to a paper read before the "Institution of Mechanical Engineers" at Birmingham, in April last, "On the Use of the Fan-blast for Manufacturing purposes." This device, about which such a *blast* was made before that Institution, seems to be nothing more than the application of Stewart's Improvement of the Rotary Fan-blower, which was patented in the United States about seven years since, viz.: on the 17th of August, 1840. (See Journal of the Franklin Institute, Vol. II,—3rd Series, page 254.) This invention was submitted to the consideration of the Committee on Science and the Arts of the Institute, and a report made by the Sub-Committee to which it was referred, on the 10th of September, 1840.

Stewart's improvement consists simply in using two, or more, fan wheels on the same shaft, each contained in a separate chamber; the current generated by the first wheel is received into a second chamber, and passes through the second, third, and so on; if more than two are used. Compare this with Mr. Buckle's recent *discovery* that "by having a succession of fans, the first delivering the blast on to the second, and so on, the pressure from the third or fourth was 2½ lbs. per square inch."

But, to the letter:

"*London, June* 3, 1847.

"Dear Sir: The inclosed paper contains a notice of the successful application to an iron furnace in Derbyshire, of the ingenious *fan-blast*, patented many years ago in the United States, and of which a model was deposited at the Franklin Institute by the inventor. As usual it has been *re-invented* and patented here, some five or six years subsequently, and will now, doubtless, be much applauded for its ingenuity and importance. As this account, however, of its first practical employment on the large scale, might possibly not be inserted in any of the Journals received by the Institute, I send this newspaper report, from the Birmingham Gazette of May 24th, in order that the Committee on Publication might be able to give an early notice of an improvement which, I cannot but think, will be of great importance to our iron manufacturers. The cost of a complete set of blowing cylinders and machinery is a serious item in the expense of starting many of our small furnaces among the mountains, where capital is scarce:—these reduplicating fans would certainly cost but a small fraction of the other; would be less liable to get out of order, and would probably require much less power. * * *

"Vulcanized India Rubber was lectured on at the Royal Institution this winter, and Mr. Brockedon then detailed the circumstances which led to its *original* discovery by Mr. Hancock some three years ago,—while Goodyear's American Patent for the same compound is dated in February, 1839."

*From the Birmingham Gazette:* "The paper of Mr. Buckle 'on

the use of the Fan-blast for manufacturing purposes," was then read; it stated that the author had tried a series of experiments, originating in the opinion that, by using a number of fans, a blast of sufficient intensity for the smelting of iron from the ore could be produced. After detailing the experiments, Mr. Buckle observed that the proper speed of revolution for the tips of the fan, whatever its size, was three-fourths of the theoretical velocity; that a greater velocity was an expenditure of power without an increase of blast; that the fan need not be made large; and that the area of the discharge and the density of the blast very nearly corresponded.—The Secretary also read a paper from Mr. Jones, of the Bridgewater Foundry, Bridgewater, corroborating the conclusions at which Mr. Buckle had arrived. In this paper it was stated that in that foundry they were manufacturing from fifty to sixty tons of iron per day by a consumption of only 200 lbs. of coke to a ton of iron, and that the engine in addition to that work, also kept from fifty to sixty smiths' fires in blast. The power required was about that of eight horses, and the pulley for driving had been proved to be superior to the strap. He had obtained those results from increasing the size of the air passages. The engine worked about seven hundred and fifty revolutions per minute.—The Chairman observed that the process as described by Mr. Jones showed extraordinary economy; and inquired whether Mr. Buckle had ascertained the relative values of long and short pipes to conduct the blast to the fire?—Mr. Buckle said he had not had an opportunity of trying. He found that, with the same number of holes open at each end of the pipe, the difference in the effect at the two extreme fires was so small that it could not be measured.—Mr. Cowper wished to ask whether the horse power mentioned by Mr. Jones was indicated, or commercial horse power. Was it the same as that indicated by Mr. Buckle?—Mr. Buckle replied that he had used a dynamometer with a spiral spring and piston, and having ascertained the power of the engine when disconnected with the fan, he had deducted that from the amount shown in every experiment. The engine was nominally fourteen-horse power. He had found that by having a succession of fans, the first delivering the blast on to the second, and so on, the pressure from the third or fourth was 2½ lbs. per square inch.—Alderman Geach said he *knew that the plan was in use at a furnace in Derbyshire, where they obtained a pressure of* 2½ *lbs. per square inch, making better iron and a larger quantity than by the old plan.*—Mr. Buckle said he was not aware that the plan had been tried; but he knew that there was a more uniform discharge from the succession of fans than from the blowing cylinder, and that the heat in the furnace was more equable.—Mr. Henderson remarked that, in Scotland, the firm with which he was connected had a fan which, although badly constructed, turned out 220 to 230 tons of castings, per week. They found that out of a Fairbairn's ordinary engine they could obtain about double the commercial power. He wished to know the proper form of the fan, and the proper length and size of the pipe; and whether, by laying down under-ground piping, they could effect their object as well as by having a shaft to conduct the

power to the place where they wanted it. They had enlarged the tuyere pipe, having ascertained that in smelting iron the density of the air was less important than its quantity, and that it was required to be admitted in large quantities.—Alderman GEACH and Mr. H. SMITH quoted several instances, which (the CHAIRMAN remarked) went to show that the further the blast was from the fire the better. —The further discussion was adjourned.

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### *Apparatus for Regulating Gas Lights.*

We find in the "*Comptes Rendus*" of August 9th, a Report made to the French Academy of Sciences, by a Committee of that body, consisting of Messrs. Poncelet, Morin, and Payen, appointed to examine and report upon two Gas Regulators, submitted for inspection by Messrs. Mutrel and Pauwels. Conceiving this to be a subject worthy of some attention, we have prepared the following translation from the Report:

It is evident that if, in every place, the pressure of gas could be fixed, and maintained at a certain point during the time of burning, it would be easy to determine the size of the openings for feeding the flame, as well as the proper dimensions of the glass chimneys for the burners, in order to obtain the greatest amount of light for a given quantity of gas consumed. It is known that this maximum is only obtained when the *excess* of air necessary to produce complete combustion is as little as possible; for then the flame will be supplied with the greatest number of incandescent and luminous carbonaceous particles in the volume of gas burned.

But all these relations change with the variation of pressure, as may be generally perceived several times in an evening, by observing an ordinary gas burner. When the general lighting up is commenced in the evening, the first burners receive the gas under a maximum pressure, which must be moderated by diminishing the opening made by the stop cock; but as soon as the lighting up has become general, and a large number of burners are in operation, the flow of gas is greatly augmented, the pressure is diminished, and it becomes necessary to enlarge the opening by further turning the stop cock, in order to maintain the flame at the proper height. A contrary effect is produced when, late in the evening, the consumers of gas begin to extinguish their lights. The pressure is then increased in proportion as the flow is checked;—the flame rises too high in the burners;—and it thus becomes necessary, at least twice in each evening, to regulate the light by having recourse to the stop cock.

The inconveniences arising from these variations will be easily understood:—

1. The management of the light is more troublesome and difficult, and the expenditure of gas is increased.

2. Notwithstanding the utmost care, changes in the intensity of

the light, more or less sudden, will occur, occasioning fatigue and embarrassment to the sight.

3. Whenever an excess of pressure is indicated by an extension of the flame, the latter, for some moments, is no longer in the normal condition resulting from an excess of air; but, from a want of oxygen, the combustion is incomplete,—the carbonaceous particles, thrown into the flame in excess, pass unconsumed out of the glass chimney, and are dispersed in the air without being burned; and even part of the gas, with its sulphurous combinations, escapes combustion. Hence arise the disagreeable smell, the tarnishing of pictures, gilding, and furniture, as well as the unwholesomeness caused by all these substances in the air of a room. *

The inconveniences which we have enumerated are serious, particularly in large assembly rooms, theatres, and other public places, where the injury done to the drapery and decorations soon shows the effect of these influences.

The only known means of avoiding these injurious consequences of the variation of pressure, consists in the employment of a regulating apparatus. For a long time efforts have been made to this effect; but difficulties have been encountered in the mode of application, besides the obstacles, natural in some degree, which are to be expected when an attempt is made to introduce into buildings any new device which requires a particular place, and changes, in the smallest degree, the usual or habitual routine of the occupants.

The two regulators which have been successively presented to the notice of the Academy, appear to be sufficiently simple, accurate, and compact, to overcome the obstacles to one of the most desirable improvements in the use of gas. Both of them, like those which have preceded them, are based upon the use of a bell-shaped vessel, or little gasometer, the simple elevation of which, occasioned by the increase of pressure, causes the partial or total closing of the tube through which the gas flows; whilst, by the contrary effect of a diminished pressure, the vessel descends, and enlarges the opening for the passage of the gas. It is very easy to ascertain the proper degree of pressure, be it greater or less, which is requisite for the burners; and then simply to charge the vessel with such a weight that it will require this same pressure to keep it elevated.

The above mentioned effects are produced, in the regulator of M. Mutrel, by a lever, of which the shorter arm sustains the vessel, while the longer sustains a movable counterweight, the effect of which may be increased or diminished by changing its distance from the fulcrum. To this lever is affixed a vertical rod, which is attached to a lever moving the axis of a valve, so arranged as to be largely open when the little gasometer is at its lowest point; but which closes in proportion as the increasing pressure of gas causes that vessel to rise. In this way the pressure and flow of gas may be regulated.

Mutrel's regulator is used in several establishments at Rouen, Paris,

* Note. The gas supplied from the Philadelphia Gas Works is so completely purified that no trace of sulphur can be detected. Com. Pub.

Batignolles, and in the signals of the Rouen railroad. In the latter, it regulates about 200 burners, and since the month of February, by its employment, not only have variations in the light been avoided; but a considerable saving in the consumption of gas has also been effected.

The regulator of Pauwels is more simple in its construction. Its useful effect is produced by a circular stopper, attached to the regulating vessel. When the pressure of gas causes this vessel to rise, the stopper moves forward in a conical tube, thus gradually checking the flow of gas, which it may even totally interrupt for an instant,—and in this manner furnishes a continued supply under a constant pressure. This regulator has been used in the theatre at Rouen for more than a year, and we have tried it with success in the Salle des Variétés at Paris.

It will be perceived that Pauwels' regulator differs from that of Mutrel, in the mode of checking the flow of gas through the tube; it has also the peculiarity that no branch, or exterior apparatus, is seen about the vessel;—and that its service cannot be deranged by an accidental shock, or by the interposition of a foreign body. It has also the advantage of allowing the regulator to be enveloped by a case of sheet iron, (cloche en tôle,) to which is affixed a discharging tube, the extremity of which, opening outside of the building, is covered with little disks of wire gauze; so that if, from any extraordinary diminution of water in the reservoir, or from any other cause, an escape of gas should occur, it would not spread throughout the building, but would be discharged into the open air.

In consideration of the interest attached to every means of producing conditions of economy, safety, and health, in the use of gas, we are induced to propose that the Academy return thanks to M. Pauwels and also to M. Mutrel, for the useful devices which they have communicated.

Note. An apparatus resembling that of Pauwels, has been used at the Philadelphia Gas Works since they first went into operation. It acts as a governor to regulate the pressure in the mains at large. Com. Pub.

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## *Extract from an account of the Prattsville Tannery in "Hunt's Merchant's Magazine."*

It would be a curious subject of speculation to inquire into the causes that have conspired to mark the American people with such an extraordinary degree of enterprise; but such an inquiry would lead us altogether too far from the immediate object of this article, which is to present a notice of one of the most striking instances of individual enterprise that our country affords. We refer to the great Prattsville Tannery, in the county of Greene—the most extensive establishment of the kind in the world, founded and conducted by the enterprise and skill of a single individual, well known for his enlarged and liberal views—the Hon. Zadock Pratt, late member of Congress from New York. A succinct, historical, and statistical account of this establish-

ment, conducted with a skill and energy which has realized a fortune to its possessor, and has been the means of spreading comfort and plenty all around him, cannot be uninteresting to the general reader, as well as to all those who are interested in a branch of manufacture which M'Culloch ranks as the fourth, if not the third, in the United Kingdom, and which probably holds a still higher rank in the United States.

For the materials of the following sketch of the Prattsville Tannery, and of the processes and extent of the manufactures carried on at that establishment, we are indebted to the kindness of the distinguished proprietor, who has now retired from the business, to enjoy the fruits of his honest, well-earned industry.

The Prattsville Tannery, as we have said, furnishes one of the most striking examples of individual energy and enterprise, which our country, fruitful as it is in such examples, affords. A little more than twenty years ago, the district of country in which it stands, was a perfect wilderness. Although just back of the well-known Catskill range, and not more than thirty-six miles from the banks of the Hudson, the great thoroughfare of our interior trade, the depths of its hemlock forests, the solitude of its mountain glens, and the flashing of its tumbling brooks, had been explored only by the foot of the hunter, and were as little known to the public as the slopes and valleys of the Rocky Mountains. In 1824, Col. Pratt visited this district, and, with unerring judgment, at once decided upon it as the proper location. With a man of Colonel Pratt's energy, from the conception of a project to its execution, is but a single step. With such men, to will and to do is one and the same thing. In less than ninety days, he had a tannery erected, and ready to commence operations.

This tannery is an immense wooden building, 530 feet in length, 43 feet in breadth, and two stories and a half high. Within this area are contained 300 vats, with conductors to draw the liquor to the pump, affording about 46,000 cubic feet of room for tanning purposes. A large wing, 40 feet by 80, extending over the stream, contains 12 leaches, six of which have copper heaters, each 28 feet long. The cubic contents of the leaches amount to about 12,000 feet, and also the bark loft, through which, in the course of the year, pass more than six thousand cords of bark. The mills through which it is ground, are capable of grinding over a cord of bark per hour, and it has connected with it a pump of sufficient capacity to deliver 1000 cubic feet of "ooze," or water charged with tannin, in 30 minutes. The beam-house contains thirty vats, equivalent to 7640 cubic feet. It has connected with it three hide-mills, for softening the dry Spanish hides, and two rolling machines, capable of rolling 500 sides of leather per day. Outside of the building, but connected with the beam-house by an under-ground communication, are eight stone sweat-pits, with pointed arches and flues. The pits are of the most approved size, being in area 10 feet by 14, and in depth 8 feet, with a spring of water at one corner.

Of the enormous amount of business done, and capital employed in this establishment, a good idea may be obtained from the following

statistical data, which have been collected and tabularized with great care from Col. Pratt's systematic books:—

STATISTICS OF THE PRATTSVILLE TANNERY FOR TWENTY YEARS.

*Various Materials Used, and Labor Employed.*

| | | |
|---|---|---|
| 6,666 acres bark land,=10 square miles,=18 cords to the acre,=120,000 cords of bark at $3 | | $360,000 |
| No. of days' work peeling and piling do. | days | 118,555 |
| 4 trees to the cord | trees | 475,200 |
| 120,000 loads, or cords,=264,000,000 lbs. | | 132,000 |
| 444 acres of woodland, 32,000 loads, or cords, worth | | 32,000 |
| 135,380 bush. oats, at 2s. 6d. | | 41,967 |
| 1,200 tons of hay at $8 | | 9,600 |
| 313,000 days' work in tannery,=1,000 years' labor, at $14 per month. | $162,000 | |
| Board at $1 50 per week, or $6 per month | 78,000 | |
| | | 240,000 |
| 500,000 hides, cost (wet, salted, and dry) | | 1,750,000 |
| 5,700 loads of 2,600 lbs. each, (one pair horses,) or lbs. | 15,000,000 | |
| 1,000,000 sides of 18 lbs. per side | 18,000,000 | |
| | | 33,000,000 |
| Cost of carting | | $52,800 |
| 3,000 lbs. per load leather, one pair horses | 6,000 | |
| 2,600 " hides | 5,700 | |
| | | 11,700 |
| Freight of hides and leather between New York and Catskill | | $30,000 |
| Equal to 18,000,000 lbs. of leather, at 17 cts. per lb. | | 3,060,000 |
| Lost and worn out about 100 horses, at $75 each | | 7,500 |
| Cost of wagons, at $250 a year | | 5,000 |
| Yearly expenses, $300,000—total expenses, about | | 6,000,000 |

A glance at this table will at once convince any one that the advantages of such an establishment are not confined to the amount of value produced. The labor employed, directly or indirectly, may be set down at two hundred men daily. The ramified branches of business and trade that it fosters, the comfort, refinement, and intelligence of which it becomes the centre, and its final influence upon the growth and populousness of the surrounding district, cannot be too highly estimated. The following table shows but one single item—the amount of labor employed within the walls, or that which is directly and immediately employed in the process of tanning; but, from a comparative inspection of it and the table above, some idea may be formed of the amount of labor indirectly engaged:

*Average Number of Men employed at the Prattsville Tannery throughout the Year, with their respective Wages per Month:—*

BEAM-HOUSE.

| | No. of hands. | Pay. | | |
|---|---|---|---|---|
| Foreman | 1 | $32 | | $32 |
| Choresmen | 2 | 12 and | $6 board. | 36 |
| Beamsmen | 12 | 14 | " | 180 |

IN THE YARD.

| | | | | |
|---|---|---|---|---|
| Foreman | 1 | 50 | | 50 |
| Handling and laying away | 8 | 12 and | $6 board | 144 |
| Brushing leather | 4 | 12 | " | 72 |
| Nightman to leaches | 1 | 14 | " | 20 |
| Grinding bark by day | 1 | 12 | " | 18 |
| " by night | 1 | 14 | " | 20 |
| Wheeling bark | 4 | 12 | " | 72 |
| Filling and pitching leaches | 3 | 14 | " | 60 |

DRYING LOFT.

| | | | | |
|---|---|---|---|---|
| Foreman | 1 | 20 | " | 26 |
| Spunger | 1 | 12 | " | 18 |
| Rollers | 2 | 15 | " | 42 |
| Hanging and taking down leather | 2 | 12 | " | 36 |

MISCELLANEOUS.

| | | | | |
|---|---|---|---|---|
| Foreman out-doors | 1 | 41 | " | 47 |
| Carpenter | 1 | 39 | " | 45 |
| Teamsters | 12 | 11 | " | 218 |
| Total | 58 | . | . | $1,120 |

The following table presents a condensed view of the operations at the great tannery, during the last five years:—

| | No. of hides rec'd at tannery. | Weight of hides. | Cartage. | Commissions. | Total value of hides. |
|---|---|---|---|---|---|
| 1841 | 30,984 | 724,168 | $291·47 | $5,701·47 | $108,758·06 |
| 1842 | 27,194 | 601,595 | 275·89 | 3,938·30 | 82,705·01 |
| 1843 | 28,433 | 630,192 | 213·24 | 4,425·64 | 78,198·03 |
| 1844 | 36,839 | 812,403 | 276·28 | 5,718·36 | 100,972·82 |
| 1845 | 20,556 | 460,798 | 154·17 | 2,920·25 | 51,176·60 |
| Total | 144,006 | 3,229,155 | $1,211·05 | $22,704·02 | $421,810·52 |

TABLE—CONTINUED.

| | Leather returned to N.Y. *Sides.* | *Pounds* | Av. w'ght per side. | Av. nett price. | Com. on leather. | Nett proceeds of leather. |
|---|---|---|---|---|---|---|
| 1841 | 61,729 | 1,211,856½ | 19·63 | $14·44 | $7,352·34 | $175,018·54 |
| 1842 | 54,323 | 995,057¾ | 18·32 | 13·93 | 5,827·08 | 138,581·05 |
| 1843 | 56,742 | 1,061,523¾ | 18·71 | 13·60 | 6,053·42 | 144,331·83 |
| 1844 | 73,590 | 1,310,779¾ | 17·81 | 12·55 | 6,895·25 | 164,517·53 |
| 1845 | 40,891 | 737,571½ | 18·03 | 11·06 | 3,420·57 | 81,595·26 |
| Total | 287,275 | 5,316,789¼ | 18·51 | $13·24 | $29,548·66 | $704,044·21 |

The tanning of leather, more than almost any other manufacture, is a chemical process, the success of which depends almost wholly upon the skill and judgment with which its complicated manipulations are conducted. To attain the requisite skill in the laboratory of the chemist, is evidently impossible; it can only be acquired in the tanning itself, by long and careful attention and observation; and perhaps there is no description of manufacture, where so much depends upon practical knowledge, and so little upon mere theory, as in the tanning of leather. The tanning of leather consists in effecting a combination between the gelatine, which is the main constituent of raw hides, and tannin: a peculiar substance, found in the bark of several species of trees—the oak and hemlock, chiefly. The processes employed are so various, and the modifications occasioned by temperature, strength of the liquor, and quality and condition of the hides, are so numerous and so different, that hardly any branch of business requires for its successful conduct a greater degree of judgment and experience, and in few arts have there been effected greater improvements. Col. Pratt informs us that since he first commenced business, the gain of weight in converting hides into leather has increased nearly fifty per cent. That is, that from a quarter to a third more leather can now be obtained from a given quantity of hides, than at the time when he learned his trade at his father's tannery, conducted in the old-fashioned way.

The great improvement in weight seems to have been gained by the judicious use of strong liquors, or "ooze" obtained from finely-ground bark, and by skilful tanning. In order to produce heavy weights, the hides should not be reduced too low in the beam-house, and should be tanned quickly with good strong liquors, particularly in the latter stage of the operation. To green hides, particularly, nothing can be more injurious than to suffer them to remain too long in weak "ooze." They become too much reduced, grow soft, flat and flabby, lose a portion of their gelatine, and refuse to "plump up." On the other hand, however, the effects of an early application of "ooze," that is too strong and too warm, to green hides, is very injurious. It contracts the surface fibres of the skin, tanning at once the external layers, so "dead," as it is termed, as to shut up the pores, and prevent the tannin from penetrating the interior. This renders the leather harsh and brittle. It will, from this, be seen, that in the question of the proper strength of liquor alone, there is room for the exercise of the greatest judgment and the most extensive experience. In the impossibility of adopting fixed rules to the innumerable variety of cases, nothing can be depended upon but the judgment of the practical tanner.

In softening hides, and preparing them for the process of tanning, a great deal also depends upon the judgment of the person superintending the operation, inasmuch as the diversities in the qualities and characteristics of hides render it impossible to subject them to anything more than a general mode of treatment. In "sweating," the character of the hides and the temperature are essential, but ever-varying, considerations. As a general rule, however, the milder the process of preparing the hides for the bark, the better. Unnecessarily severe or

prolonged treatment is inevitably attended with a loss of gelatine, and a consequent loss of weight and strength in the leather. Too high a temperature is particularly to be avoided.

In almost every lot of hides, particularly the Oronocos, however, there are generally some that prove very intractable—resisting all the ordinary modes of softening. For such, a solution of ashes, potash, or even common salt, will be found to be beneficial.

As we have said, no precise rule can be given as to the length of time required for the preliminary process of soaking and "sweating" —so much depending upon the qualities of the hides, and the temperature at which these operations are conducted.

The following table, however, may be found useful in conveying an approximation to a definite idea of the practice in the Prattsville Tannery:—

| Temperatures. | SOAKING. | | | | | | SWEATING. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 40° | | 50° | | 60° | 70° | 40° | | 50° | | 60° | 70° |
| | *Days.* | | *Days.* | | *Days.* | *Days.* | *Days.* | | *Days.* | | *Days.* | *Days.* |
| Buenos Ayres hides | 10 to 12 | | 8 to 12 | | 6 to 8 | 3 to 6 | 15 to 20 | | 12 to 16 | | 8 to 12 | 2 to 3 |
| Carthagena and Laguira | 8 | 12 | 7 | 9 | 5 7 | 2 5 | 15 | 20 | 10 | 15 | 6 8 | 2 3 |

Salted hides do not require more than about two-thirds the time to soak, but about the same time to sweat.*

After the hides are prepared for tanning, the next process is, what is commonly called "handling," which should be performed two or three times a day in a weak ooze, until the grain is colored, new liquor being preferable to old. They are then, after a fortnight, laid away in bark, and changed once in two to four weeks until tanned. Much care and judgment is requisite in proportioning the continually increasing strength of the liquors to the requirements of the leather in the different stages of this process. The liquors should also be kept as cool as possible, within certain limits; but ought never to exceed a temperature of eighty degrees. In fact, a much lower temperature is the maximum point, if the liquor is very strong—too high a heat, with a liquor too strongly charged with the tanning principle, being invariably injurious to the life and color of the leather. From this, it would seem that time is an essential element in the process of tanning, and that we cannot make up for the want of it by increasing the strength of the liquor, or raising the temperature at which the process is conducted, any more than we can fatten an ox or a horse, by giving him more than he can eat. It may be questioned whether any patented schemes for the more rapid conversion of hides into leather, will be found, on the whole, to have any practical utility.

We have mentioned the injurious effects resulting from too strong a solution of the active principle of the bark; on the other hand, the use of too weak solutions is to be avoided. Hides that are treated with liquor below the proper strength, become much relaxed in their texture, and lose a portion of their gelatine. The leather necessarily loses in

* In sweating, the temperature rises as the hides sweat, so that the operation is seldom performed under 50°. It is particularly recommended that, for the tougher hides, the heat should never be greater than 60° or 65°.

weight and compactness, and is much more porous and pervious to water. The warmer these weak solutions are applied, the greater is this loss of gelatine. To ascertain whether a portion of weak liquor contains any gelatine in solution, it is only necessary to strain a little of it into a glass, and then add a small quantity of a stronger liquor. The excess of tannin in the strong solution, seizing upon the dissolved gelatine in the weak liquor, will combine with it, and be precipitated in flakes of a dark curdled appearance, to the bottom. At the Prattsville Tannery, the greatest strength of liquor, used for handling, as indicated by Pike's barometer, is 16°. Of that employed in laying away, the greatest strength varies from 30° to 45°.

After the leather has been thoroughly tanned and rinsed, it will tend very much to improve its color and pliability to stack it up in piles, and allow it to sweat until it becomes a little slippery from a kind of mucus that collects upon the surface. A little oil added at this stage of the process, or just before rolling, is found to be very useful.

Great caution is necessary in the admission of air in drying, when first hung up to dry. No more air than is sufficient to keep the sides from moulding should be allowed. Too much air, or, in other words, if dried too rapidly in a current of air, will injure the color, giving a darker hue, and rendering the leather harsh and brittle. To insure that the thick parts, or butts, shall roll smooth and even with the rest of the piece, it is necessary that the leather should be partially dried before wetting down for rolling, and that, when wet down, it should lay long enough for every side to become equally damp throughout.

The following table, condensed from the tanning records of 200,000 sides, exhibits the time required to tan the various descriptions of hides at Col. Pratt's establishment, during a period of four years. It will be seen that the same description of hides require different times in different years. This is owing mainly to a difference in the temperature and weather of the several seasons, and the quantity of sides and strength of liquor in the vats, and partly to the different conditions and qualities of different lots of the same descriptions of hides:—

| | No. of sides. | Time of tanning. mo. | ds. |
|---|---|---|---|
| 1841—San Juan | 7,500 | 4 | 20 |
| Oronoco | 3,500 | 5 | 15 |
| " | 1,900 | 6 | .. |
| " | 9,000 | 6 | 10 |
| Laguira | 22,000 | 7 | 15 |
| Oronoco | 6,500 | 5 | 15 |
| Matamoros | 1,100 | 5 | .. |
| " | 2,300 | 5 | 20 |
| San Juan | 6,500 | 4 | 15 |
| Montevideo | 5,800 | 4 | .. |
| 1842—Honduras | 3,600 | 6 | 20 |
| Buenos Ayres | 10,500 | 6 | 10 |
| Chagres | 1,700 | 6 | .. |
| 1843—Oronoco | 1,100 | 5 | .. |
| Montevideo | 2,700 | 5 | .. |
| 1843—Rio Grande | 5,800 | 4 | 20 |
| 1844—Buenos Ayres | 6,500 | 6 | 20 |
| Oronoco | 5,400 | 7 | .. |
| California | 1,200 | 6 | 20 |
| Buenos Ayres | 900 | 7 | 10 |
| " | 6,500 | 5 | 10 |
| Oronoco | 1,500 | 4 | 20 |
| Rio Grande | 2,100 | 5 | .. |
| " | 4,000 | 5 | 10 |
| Oronoco | 2,800 | 6 | 10 |
| Laguira | 5,100 | 7 | .. |
| Rio Grande | 1,100 | 7 | .. |
| Buffalo | 2,000 | 5 | .. |
| Buenos Ayres | 2,000 | 6 | .. |
| Rio Grande | 8,500 | 6 | 10 |

From this, it will be seen that the average time of tanning in 1842, was five months and seventeen days; of 1843, five months and twenty-two days; of 1844, six months, and of 1846, six months and eleven days. Average of the whole time, five months and twenty-seven days. The average weight of the leather was seventeen pounds per side. This, according to the best authorities we have at hand, is considerably below the time employed in England. There, it is no uncommon thing for eight and ten months to be employed in tanning a stock of leather, and some of the heaviest leather, it is said, takes even fourteen and fifteen months. Such deliberation undoubtedly insures a fine quality of leather, but it may be questioned whether there is not a great loss in the increase of weight—a loss of interest on capital, and in consequence an unnecessary enhancement of price.

It would be wrong in us to conclude a notice of this useful mechanical establishment, without a word or two respecting the flourishing village which it has been the means of creating. Twenty years ago, there stood a dense wilderness of hemlock, and now a beautiful village of nearly two thousand inhabitants occupies its place. The village was laid out in lots, by Colonel Pratt, on which he has erected "his hundred houses." The main street is nearly a mile in length, upon either side of which is a row of beautiful maple and elm trees, and a neat gravel walk, running the whole length of the street. These improvements were the work of the founder of the village entirely. The houses and the buildings are placed on a line at the distance of twenty feet from the street, and generally painted white. The village now contains three churches, an academy, four schools, two woollen factories, making 500 yards of cloth per day, one cotton manufactory, three machine-shops, three grist-mills, three saw-mills, two mitten and glove factories, one India-rubber factory, a printing-press, besides watch-makers, cabinet-makers, coopers, and other mechanics. There are also seven stores, three hotels, and a post-office, the amount of the business of which may be judged of, from the fact that its receipts have increased from $5 to $500 per annum. It is in contemplation to make Prattsville the centre of a new county. And from this hemlock tannery the persevering founder of this village has grown a bank, with a capital of $100,000. Col. Pratt's establishment has thus furnished a nucleus around which has clustered the habitations of civilization and refinement, and has thus proved the agent of fulfilling in its immediate sphere the prophetic words, "the wilderness shall blossom as the rose."

Of this enterprising Tanner, Farmer, Legislator, and Banker, it may be truly said, that he has been the architect of his own fortune. He has conducted his vast business without a single case of litigation, never impeding the course of others, but always lending a liberal hand; and has learned the value of his own maxims of "letting well enough alone," and of "doing well enough," by "minding his own business."

### *On Lord Rosse's Telescope.*

Dr. Robinson, when giving, in November, 1840, to the Academy, an account of the three-feet telescope constructed by the Earl of Rosse, had announced to them the intention of that nobleman to attempt an instrument of double aperture and focal length. The attempt had succeeded even beyond expectation, and he hoped that a brief notice of its progress and results would not be uninteresting; more especially as he felt that the approbation with which they had received his former communication, and the importance which they attached to Lord Rosse's discoveries, had not been the least powerful cause of the triumph which their countryman has now achieved.

The speculum was cast on the 13th of April, 1842, according to the principles which had been so successfully applied to the smaller mirrors; but with several changes of the details, made necessary by the gigantic scale of the work.

It is well known to all who have experimented on specula, that the alloy must be formed in the first instance, and re-melted for casting at a much lower heat: otherwise the mirror is full of pores. The fusion must, in both cases, be effected in covered crucibles, to preserve the definite proportions of the alloy, which would be *lowered* by oxidation of its tin if exposed to the draught of the furnace. It is also necessary that the speculum be of uniform composition and superficial density; and, as it is impossible to fuse the requisite quantity of metal for one of six feet in a single vessel, the different portions must flow into the mould under circumstances as nearly as possible identical. Much thought and many experiments must have been expended before these conditions were so completely fulfilled. The crucibles are, of course, cast iron; no earthen one being able to bear the pressure of such a mass of fluid metal at so high a temperature. They are thirty inches internal depth, and twenty-four diameter, weighing about half a ton each, and manufactured with the precautions pointed out by Lord Rosse (Phil. Trans. 1840). Notwithstanding their great strength, they yield so much that it is obviously hazardous either to use them frequently or to increase their dimensions. They were employed at once, each containing about one and a half tons of the alloy; they were placed in furnaces whose mouths were level with the ground, eight feet deep and four in diameter, disposed round a large stack or chimney, into which their flues vent. The fuel is turf, peculiarly fitted for this work, as giving a much more manageable heat than coke; about 2200 cubic feet of it are consumed in a casting. The furnaces were filled with fuel, and ignited at the top, on the preceding evening, that the crucibles might be gradually heated; and in about ten hours they were ready to receive the metal. This was unintentionally made of a lower standard than that of the three feet, in consequence of the atomic number for tin being taken as given in Turner's Chemistry, 57·9 instead of 58·9, causing a deficiency of about half per cent., too trifling to impair materially its reflective power, though it will certainly make it more liable to tarnish. That

its uniformity might be insured, each ingot of it was broken into three pieces, as nearly equal as possible, and stored in three casks, each of which contributed equally to form the successive charges of the crucibles in an order regularly varying. They were charged at intervals of two hours, and the whole was fused in twelve: they were then withdrawn from the furnaces by a powerful crane, and transported to the iron cradles of pouring frames, arranged 90° asunder round the mould.

The essential part of the mould is its base, composed of hoop iron six inches broad, packed on edge in a strong frame seven feet diameter, and supported by strong transverse bars below. The upper surface was turned to a convex segment of a sphere, 108 feet radius, on the polishing machine, over which a self-acting slide rest was fixed, whose frame was of the same curvature. This process required several weeks, and it was then ground smooth by a frame filled with concave blocks of sandstone. The bed of hoops so prepared being set exactly level, and heated sufficiently to blue its surface (for the purpose of burning out the tallow with which its interstices are filled, when not in use, to protect it from oxidation), the wooden pattern of the speculum was placed on it, and founders' sand rammed round it to its top. The mould thus formed was about a foot deep; the thickness of the speculum, 5¼ inches in this instance, being determined by the quantity of metal melted. By this arrangement, as Dr. Robinson formerly explained to the Academy, the fluid metal which comes in contact with the hoops is *chilled* at once into a dense sheet about half an inch thick; the air which might be entangled with it in pouring, escaping through their interstices. The circumference sets much more slowly in consequence of the inferior conducting power of the sand; and the upper surface, which is only in contact with air, remains so long fluid, that the greatest part of the shrinkage occurs there; its tendency to crack the cast is prevented, and the coarse structure which it produces is confined to a place where it is unimportant.

On this occasion, besides the engrossing importance of the operation, its singular and sublime beauty can never be forgotten by those who were so fortunate as to be present. Above, the sky, crowded with stars and illuminated by a most brilliant moon, seemed to look down auspiciously on their work. Below, the furnaces poured out huge columns of nearly monochromatic yellow flame, and the ignited crucibles, during their passage through the air, were fountains of red light, producing on the towers of the castle and the foliage of the trees, such accidents of color and shade as might almost transport fancy to the planets of a contrasted double star. Nor was the perfect order and arrangement of every thing less striking; each possible contingency had been foreseen, each detail carefully rehearsed; and the workmen executed their orders with a silent and unerring obedience worthy of the calm and provident self-possession in which they were given.

It has been found that a good criterion of the time for pouring the alloy into the mould is afforded by stirring it with a pole of dry wood. This, as long as the temperature is above a certain point, reduces the

film of oxide which covers its surface; and it becomes clean and bright, though a new film forms immediately. At length as it cools this reduction no longer occurs; and at a signal the three crucibles are emptied into the mould by means of levers connected with the pivots of their cradles. Though familiar with heavy castings, Dr. Robinson had never seen anything so magnificent as the burning lake that was then produced; and for many minutes it rolled in heavy waves like those of quicksilver, which broke in a surf of fire on the sides of the mould, effecting the most perfect mixture of the metal. At last it became solid; and was examined as it cooled, till it barely yielded to pressure with an iron rod at its centre, which is the indication that it may be removed to the annealing furnace.

This furnace extends along the fourth side of the mould: it is a low square chamber lined with firebrick, with sides about thirty inches thick, strongly hooped, and covered by an arch, from the centre of which rises a flue. Its floor is convex, of the same curvature as the speculum, and is heated from beneath by nine arches, which communicate with lateral flues. It opens towards the mould by a low arch a little wider than the speculum; but behind has merely an aperture to admit an iron bar. For some weeks the chamber and arches had been kept full of burning turf, so that the whole interior was of a full red heat. The speculum, also red hot (at which temperature, it is to be remarked, the alloy has nothing of that brittleness which characterizes it when cold, but is as tough as malleable iron), was cleared from the sand, and encircled by a strong ring attached to the bar above mentioned. By connecting this bar with a powerful capstan, it was drawn from the bed of hoops, along strong beams covered with iron, to its place in the centre of the annealing furnace. The ring was then removed, and the rest of the chamber filled up with charcoal; the arches with fuel; all the flues and apertures were closed carefully with masonry, and it was left to cool gradually for sixteen weeks, during the first three of which the exterior of the building was sensibly warm.

In the course of this year considerable progress was made with various parts of the mounting; and when Dr. Robinson visited it in February, 1843, he found that the speculum had been ground on a machine similar to the old one, but of strength proportioned to its work; that the foundations of the piers were laid, the tube was in preparation, and the massive frame-work and levers by which the speculum is supported in the tube were cast. This elegant contrivance requires some explanation. Suppose the back of the mirror divided by two concentric circles into three portions, of which the central circle is cut by radial lines into six sectors, the middle zone into nine segments, and the exterior into twelve, and that all of these are equal. If each of these be supported by an equal force applied at its centre of gravity, the speculum is obviously in the most favorable condition as to flexure. The frame mentioned above is rectangular, with a cross-piece cast in one, and weighs one ton and a half; it bears three strong triangles, also of cast iron, supported at their centres of gravity on hemispherical bearings. Each angle of each of these bears a similar

triangle, the angles of which give the twenty-seven points of equilibrated bearing for the speculum. They do not, however, press directly, but carry platforms of cast iron of the shape of the areas which they are to bear, and made exceedingly stiff by flanches at their edges, and by edge-bars crossing them diagonally. A layer of felt is over these; strong uprights from the frame of a similar character prevent any lateral shifting; and the operation of the arrangement is found to be perfect at all altitudes.

The construction of the tubes, the piers, the mechanism of the counterpoises, occupied the remainder of this year and the beginning of 1844. In August, a partial polish was given to the mirror in order to verify its focal length (which was found exactly fifty-four feet); and the observing galleries and the apparatus for controlling the instrument in right ascension were proceeded with. All these gigantic constructions (of whose prodigious mass some idea may be formed from the fact that they contain, along with their other materials, more than one hundred and fifty tons of iron castings), have been executed in Lord Rosse's workshops, by persons taken from the surrounding peasantry, who, under his teaching and training, have become accomplished workmen, combining with high skill and intelligence the yet more important requisites of steady habits and good conduct. It may also be mentioned that (such was the clear and definite arrangement of the whole in its inventor's mind) nothing failed from first to last; and it was not necessary for him in any instance to retrace his steps.

At the beginning of February, 1845, the work being sufficiently advanced to permit the use of the instrument without personal danger, Dr. R. and his friend Sir James South were invited to enjoy the trial of it. Its appearance is certainly peculiar, and presents a striking contrast to the more complicated framing of the three-feet telescope which is placed beside it. At first sight, one wonders how it is to be moved, for nothing attracts notice except the massive piers and the tube; but a nearer approach shows that it is the perfection of mechanical engineering. To have mounted it on the plan of the three-feet would have been impracticable as well as useless. The speculum with its supports is seven times the weight of that in Herschel's four-feet, and both on this account, and the well-known principle that similar machines are weaker in proportion to their bulk, such a stand must have been so heavy as to present great obstacles to its motion. The vast surface exposed to the action of wind must have made it unsteady; and its durability could not be great. Lord Rosse, therefore, determined to confine the range of observation to the vicinity of the meridian. There the stars are at their greatest altitudes, and atmospheric influences effect them least; their places can be determined with most accuracy, and an equatorial movement, so essential to micrometer measures, can be easily obtained. With such optical power there will never be a scarcity of objects for examination; and the restriction will only be felt in the case of planetary bodies. The base of the actual mounting is a very massive joint of cast iron; its lower axis permitting motion in the meridian plane, its upper in a direction perpendicular to that circle. On this is firmly bolted a cubical wood-

en chamber, about eight feet wide, in which the speculum is placed, one of its sides opening for the purpose. This again carries the tube, which, when vertical and viewed from the interior of the chamber, is more like one of the old round towers than any more ordinary object of comparison. It is fifty feet long, eight feet in diameter in the middle, but tapering to seven at the extremities: it is made of deal staves an inch thick, hooped with strong iron clamp-rings, and secured from collapse by iron diaphragms; and carrying at its upper extremity the apparatus of the Newtonian small mirror, which, from its great weight and bulk, requires to be counterpoised. The telescope is moved in declination by a strong chain cable attached to its top and passing over a pulley fixed at a proper height to the north, down to a windlass on the ground which is wrought by two workmen. East and west, near the top of the piers, large iron pulleys are fixed, having free movement in azimuth, so that their planes may always be in those of the traction: chains suspending the counterpoise weights pass over these to the sides of the tube. The weights, however, are constrained to descend in quadrants of circles by chain guys attached to the frame which bears the declination pulley. It is easily seen that their action is a maximum when the tube is level, and nothing when it is vertical: but between these positions it decreases more slowly than the downward tendency of the tube. To correct this, the tube is connected with loaded levers (placed to its south), by chains of such lengths that one of them is not raised till it is at 40° altitude, and the other at 80°; the latter being necessary for the return of it after it has passed the zenith. The slow motion in declination was not yet applied, but the ordinary one was quite convenient, except for the difficulty of giving orders to the men, who were sometimes seventy or eighty yards from the observer. A two-feet circle, with a fine level and a pair of verniers, will also be attached to the tube to give the declination; its place was then supplied by a small protractor, five inches diameter, over which was a strong screen to protect the assistant who attended it from any such casualty as the fall of an eye-piece.

The eastern pier bears what may be called the meridian of the instrument: it is a strong semicircle of cast iron, about eighty-five feet diameter, and composed of several pieces accurately planed. Each of these is bolted to the pier and separately adjustable to a meridian line formed by straining a fine wire over notches in two cast iron chairs firmly secured at the north and south of the masonry. Sir James South took charge of this delicate operation, and performed it with such precision that when a transit instrument was adjusted by this line, it gave the passage of Polaris *to a small fraction of a second.* The telescope is compelled to move in the meridian, being connected with this circle by a strong bar provided with friction rollers, that it may traverse it easily; and thus it can be used as a transit instrument with considerable precision. But this bar is racked, and attached to the tube by wheelwork, so that a handle near the eye-piece enables the observer to move it on either side of the meridian, and thus examine it before its passage, or follow its motion. The movement is surprisingly easy; and a rough graduation on the bar supplies

at present the place of an hour circle for finding objects, for which it is quite sufficient, except that the strong light required to set it disturbs the repose of the eye. The elder Herschel has not in the least exaggerated the importance of this, when faint objects, especially nebulæ, are to be examined; and a better contrivance is to be applied: The rack being perpendicular to the meridian, gives a motion not strictly equatorial, but easily made so: had the declination pulley been in a parallel to the earth's axis, passing through the great joint, and had this latter been itself equatorial, this would have been the case; but the deviation is easily corrected by the addition of a second pulley altering the direction of the chain. Its range is half an hour on each side of the meridian for a star at the equator; and Lord Rosse intends to effect it by clock-work, as is now generally the case in large equatorials; though the problem is much more difficult than in those instruments.

The western pier supports the stairs and galleries destined to the observers. Up to 42° of altitude is commanded by the first of them: a strong and light prismatic framing slides between two ladders attached to the southern faces of the piers: it is counterpoised and is raised to any required position by a windlass; its upper plane affords support for a railway on which the observing gallery moves about twenty-four feet east and west, two of its wheels being turned by a winch near the observer. Three other galleries in succession reach to 5° below the pole; these are each carried by two beams which run between pairs of grooved wheels, and are drawn forward, when they are turned, by a mechanism of singular elegance. These are able to hold twelve people, but one man can easily work them; and though it is rather startling to a person who finds himself suspended over a chasm sixty feet deep, without more than a speculative acquaintance with the properties of trussed beams, all is perfectly safe. Every bearing part has been *proved* to ten times its utmost probable load, and the doors of the galleries open inward, and are kept close by springs. From this point too is obtained the most distinct perception of the telescope's prodigious bulk, which at a greater distance is not so striking, for want of a standard of comparison; yet, notwithstanding the hugeness of the masses to be moved, so effective are all the arrangements that Sir James South found it was possible to uncover the mirrors and find a given star in less than eight minutes.

(To be continued.)

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## *New Process for Heating the Blast of Furnaces without Coal or Labor.*

In our last Journal,* we briefly alluded to the important invention of Messrs. Dixon and Budd, of the Ystalyfera Iron-Works, by which a great improvement has been effected in the manufacture of iron. The process is so well explained by the patentees, that we prefer adopting their own description and drawings, that our readers may

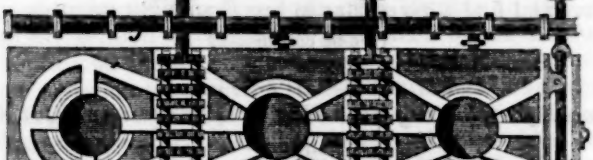
* Mining Journal, No. 618.

understand the nature and advantages of the system, as practised by themselves:—

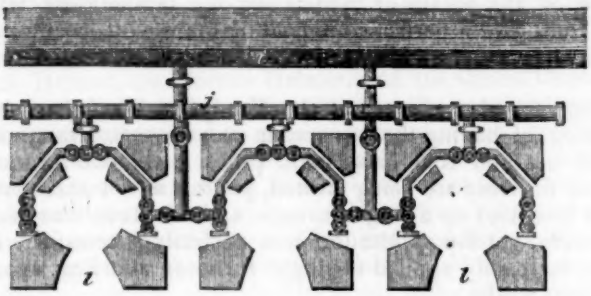
## HOT BLAST.

***Plan and Elevation of Blast Furnaces, with Sections; showing the method of Heating the Blast, according to Dixon and Budd's Patents, as practised for working Six Furnaces at the Ystalyfera Iron-Works.***

*a.* Cross section, through heating-stove and furnace, showing—
*b b.* Hot air tubes.
*c.* Inlet pipe, for cold air.
*d d.* Outlet pipes, for hot air to tuyeres.
*e e.* Flues, for heating the stoves from furnaces.
*f f.* Iron doors, for admitting air and cooling stoves.
*g g.* Top and roof of stoves.
*h h.* Stacks, with dampers to regulate heat in stoves.



*ii.* Cold blast main.
*j j.* Hot blast main.
*k k.* Horizontal section of furnaces, heating flues, and stoves.




*l l.* Ground plan of furnaces, and hot blast pipe communication with tuyeres.

The patentees, in introducing to the notice of the iron trade their improvements in the manufacture of iron, do so with the confidence arising from continued and successful practice. They preferred the delay of waiting until they were in this strong position, rather than call the attention of the trade to their plans, whilst they were in the state to which all practical men have a well-grounded aversion—viz., that of an experiment.

The patentees can now confidently assure the trade, that their patented improvements for heating the blast of iron furnaces, as set forth in the accompanying plan, possess the following advantages:—

1. The first cost of erecting the apparatus is considerably less than that usually employed.
2. The liability to get out of repair is much less.
3. The temperature of the blast can be preserved higher, and more equal.
4. There is no cost of coal or labor—neither being required.
5. The working of the furnace is not at all interfered with.
6. The stoves can be readily cooled down without derangement of the apparatus, when cleaning or repair is required.

The patentees, being ironmasters themselves, know that no saving in first cost, coal, or labor, would be considered by the trade as a compensation for frequent repairs. They also know that in many instances the whole benefit of the hot-blast process, and in some instances more than such benefit, has been swept away by the cost and irregularity attendant on the repairs of the apparatus. But they can assure the trade, that their apparatus is not liable to get out of order. At the Ystalyfera Iron-Works the hot-blast pipes that were put to work in October, 1844, are still at work and in good repair. They believe that there is nothing in the whole experience of the trade equal to this duration; but more than this, they are sanguine that where their improvements are carried out under their instructions, the stoves will last longer than the furnaces. At the Ystalyfera Iron-Works, near Swansea, six furnaces may be seen in operation, the blast being perfectly heated to the point of melting lead, by the plan of the patentees applied to five heating stoves. The dampers on the

stacks afford the means of moderating the temperature, whilst the doors in front give a perfect command of the stoves, as the draught can be reversed, and a current of cold air introduced at a moment's notice.

Although the plan adopted at the Ystalyfera Works, as shown in the drawing, of having the furnaces in one connected range of buildings, with hot and cold blast main pipes, is the one recommended where new furnaces are being erected, yet this is not essential. The plan was first tried on a single furnace, and the stove was heated on one side only, yet the application was perfectly successful. It may, therefore, be readily applied to single furnaces standing apart, as is usual in iron-works.

As the benefits arising from the adoption of the plans of the patentees amount to many shillings a ton of iron made (a most important consideration in these times of competition, especially where large quantities are made weekly), besides great comfort and regularity, the patentees respectfully invite the attention of the trade to the subject. In order to ensure an early and extensive use, they have resolved on making a very moderate charge only for their patent right. As the hot-blast apparatus at present in use, requires such frequent renewal and repairs, opportunities will occur in every iron-works, within a short period, of introducing the plans of the patentees without any, or with only a small additional, charge as dead outlay.

The patentees, therefore, congratulate themselves on being enabled to present to their brother ironmasters a plan by which all the benefits of the hot-blast process may be secured, free from the hitherto great drawbacks of current expenses and repairs. They have not attained this end without great cost and perseverance; and they look for a liberal support from the trade, now that they present their improvements in the manufacture of iron, freed from all the doubt and risk of an experiment. Min. Jour.

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### *On the Manufacture of Shell Cameos. By* Mr. Gray.

The author commenced by stating that the ancients formed cameos by engraving figures in low relief on different kinds of siliceous stones; and generally selected for that purpose those which had layers of different colors: so that the figures, or different parts of the same figures, were of divers colors. Such cameos are now made in Southern Europe and in France—where this art has lately been attempted to be revived; but the hardness of the materials requires so much labor that they are too expensive to come into general use. Numerous attempts have been made to substitute various materials, such as porcelain and glass, for the ancient cameos; but their great inferiority has caused them to be neglected. The best, and now most used, substitutes are shells; several kinds of which afford the necessary difference of color, and are at the same time soft enough to be worked with ease, and hard enough to resist wear. The shells used are those of the Flesh-eating Univalve—which are peculiar as being formed of three layers of calcareous matter, each layer being a perpendicular lamina placed side by side. The cameo cutter selects those shells which have the

three layers composed of different colors, as they afford him the means of relieving his work; but the kinds now employed, and which experience has taught him are best for his purpose, are the Bull's Mouth, the Black Helmet, the Horned Helmet, and the Queen Conch. The two first are the best shells. After detailing the peculiarities of these shells, the writer proceeded to give an account of the progress of the art, which was confined to Rome for upwards of forty years, and to Italy until the last twenty years, at which period an Italian commenced the making of them in Paris; and now about 300 persons are employed in this branch of trade in that city. The number of shells used annually, thirty years ago, was about 300; the whole of which were sent from England—the value of each shell in Rome being 30*s.* To show the increase of this trade, the number of shells used in France last year was nearly as follows:—

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|---|---|---|---|---|---|---|
| Bull's Mouth | 80,000, | average price | | 1*s.* 8*d.*, | value | 6,400*l.* |
| Black Helmet | 8,000, | " | " | 5*s.* 0*d.*, | " | 1,800*l.* |
| Horned Helmet | 500, | " | " | 2*s.* 6*d.*, | " | 60*l.* |
| Queen Conch | 12,000, | " | " | 1*s.* 2½*d.*, | " | 700*l.* |
| | 100,500 shells, | | | | | Sterling £8,960 |

The average value of the large cameos made in Paris is about 6 fr. each: giving a sterling value of 32,000*l.*; and the value of the small cameos is about 8,000*l.*—giving a total value of the cameos produced in Paris for the last year, of 40,000*l.*; while in England not more than six persons are employed in this trade.—*Proc. Soc. Arts.*

Athenæum.

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*Proceedings of the Annual Convention of Inventors, held in the city of Boston, Massachusetts, in September,* 1847.

Communicated for the Journal of the Franklin Institute.

The third annual convention of Inventors and others interested in inventions and patents, convened in the city of Boston, on the 22nd Sep. inst., in pursuance of a call of the executive committee, authorized by the last convention of Inventors of the United States, held in the city of Philadelphia, October 27, 1846.

The convention was called to order by Col. E. Clarke, of N. Y., George Daracott, Esq., of Boston, was chosen President, and J. J. Greenough, Esq., of Washington, D. C., Secretary. On motion of Mr. Keller, of N. Y., the convention then adjourned to 9 o'clock the next day.

23d. The convention met pursuant to adjournment, and further organized by electing Hon. Judge Phillips, of Boston, and Col. E. Clarke, of N. Y., Vice Presidents, and Geo. Gifford, Esq., of N. Y., an additional Secretary.

The chairman of the executive committee, appointed at the last convention, reported the proceedings of the committee during the interim, and also read the bill proposed to be passed by Congress, together with sundry amendments proposed by the committee, giving their reasons for the changes suggested. He also explained the course of proceedings in Congress in relation to the bill, during the last session, and the

causes of its failure at that time—and further urged the necessity of increasing the salaries of the Examiners of Patents if competent persons are expected to be retained by the Government in that capacity. These sentiments met a hearty response in the convention, and all who spoke on that subject agreed that the matter deserved the attention of Congress, and expressed a hope that prompt action might be had on it at the next session.

After some general conversation in relation to the report of the committee, it was accepted: and the thanks of the convention were voted to them for the ability and zeal with which they had discharged their duties. The report was then referred to an executive committee of five with authority to bring the amended law before Congress, at its next session, with power to modify the sections; for which purpose, all who are interested can address to either of the committee (post paid) such suggestions and alterations as they may deem expedient. This committee consists of the following gentlemen:—C. M. Keller, and H. Allen, Esqs., of N. Y.; Frederick Emerson, Esq., of Boston; J. J. Greenough, Esq., of Washington, and Jordan L. Mott, Esq., of N. Y.

It was voted, That the Hon. Judge W. Phillips be requested to aid the committee in revising the law, and that they submit it to him therefor. It was also voted, That the executive committee be requested to call another convention at such time and place as they may deem expedient. The convention then adjourned *sine die.*

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### *Circular from the Executive Committee of the Convention.*

To Inventors and all others interested in Patents for useful Inventions.

The executive committee, appointed by the convention of Inventors convened in the city of Boston, on the 22d of Sept. last, to take into consideration the best mode of obtaining amendments to the existing law of Patents, were instructed to receive and consider all suggestions that might be submitted to them in relation to the objects of the convention. In accordance with this instruction of the convention, all persons interested in the amendment of the law of Patents are requested to transmit any suggestions which they may have to make on this important subject to the chairman of the executive committee, Charles M. Keller, No. 304, Broadway, New York. All communications by mail to be post paid.

C. M. Keller,
*Chairman of the Executive Committee.*

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## FRANKLIN INSTITUTE.

### *Monthly Meeting, Sept.* 16, 1847.

At this meeting the subjects and communications presented, connected with Science and the Arts, were less numerous than on many former occasions.

After the reports of officers and committees, the proposal and election of new members, and other stated business had been concluded:—

*Mr. G. W. Smith* gave an account of some experiments made by himself, Prof. Cresson, and Mr. Foulke, at the newly erected Berks' County Prison, with regard to the prevention of communication between the prisoners by means of transmitted sound. He referred to the importance of such prevention, in establishments intended to carry out the principle of separate confinement; as well as in asylums for the insane, and other public institutions. In the Eastern Penitentiary of Pennsylvania, where the ventilating flues afforded a medium of communication, an attempt was made to prevent it by the insertion of iron plates, which, however, were found to be objectionable on account of their obstructing the ventilation.

The Berks County Prison, at Reading, is well designed and constructed, and has cost, in its erection, about $55,000. Particular care has been taken to secure a proper ventilation and warming throughout the building. This is attained by means of a tall chimney shaft, with which all the ventilating flues are connected; warm air being communicated to each apartment near the ceiling, and the foul air carried off by an opening into the ventilating flue, near the floor. In order to prevent communication between the prisoners, by means of sound transmitted through these flues, two enlargements are made in them about ten feet apart, in each of which is inserted an earthen vessel having the form of a paraboloid. The sound, falling upon these paraboloids, is reflected in such manner as to destroy its effect. In order to test practically the effect of this improvement, the committee distributed themselves in different cells, and found that, by the utmost exertion of voice, they were unable to make themselves heard from one cell to another. A curious proof of this was afforded by the fact, that after some of them had shouted until they were hoarse, they were visited by others who came from a neighboring cell, to inquire why they had not commenced the experiment of calling to them through the flue.

Referring to other contrivances for this purpose, Mr. S. said that slates, placed in a triangular form in the flues, had been tried in the Pentonville Prison, in England; but he doubts whether this will be found so effectual as the paraboloid. With regard to the expense of this arrangement in the Berks County Prison, he said that the cost of the paraboloid, which is made of common pottery, being but twenty cents, is more than compensated by the saving of masonry consequent upon the enlarged spaces left in the flues for their reception.

*Mr. Trego* laid before the meeting some specimens of lead and copper ores, which had been recently presented for the cabinet of the Institute. The lead ore was found in the neighborhood of Phœnixville, in Chester County, about twenty-eight miles from Philadelphia. It appears to be chiefly a phosphate of lead, mostly in amorphous masses, though occasionally presenting crystaline forms.* The proprietor is

* Since the above notice was written, a specimen of this ore has been analyzed by Dr. M. H. Boyé, of this city, with the following result:—100 parts of it contain, oxide of lead, 75·99; oxide of iron, 4·82; phosphoric acid, 13·56; silica and insoluble silicates, 2·50; water and other volatile matter, 1·25; muriatic acid, and loss, 1·88. It contains 70·53 per cent. of metallic lead.